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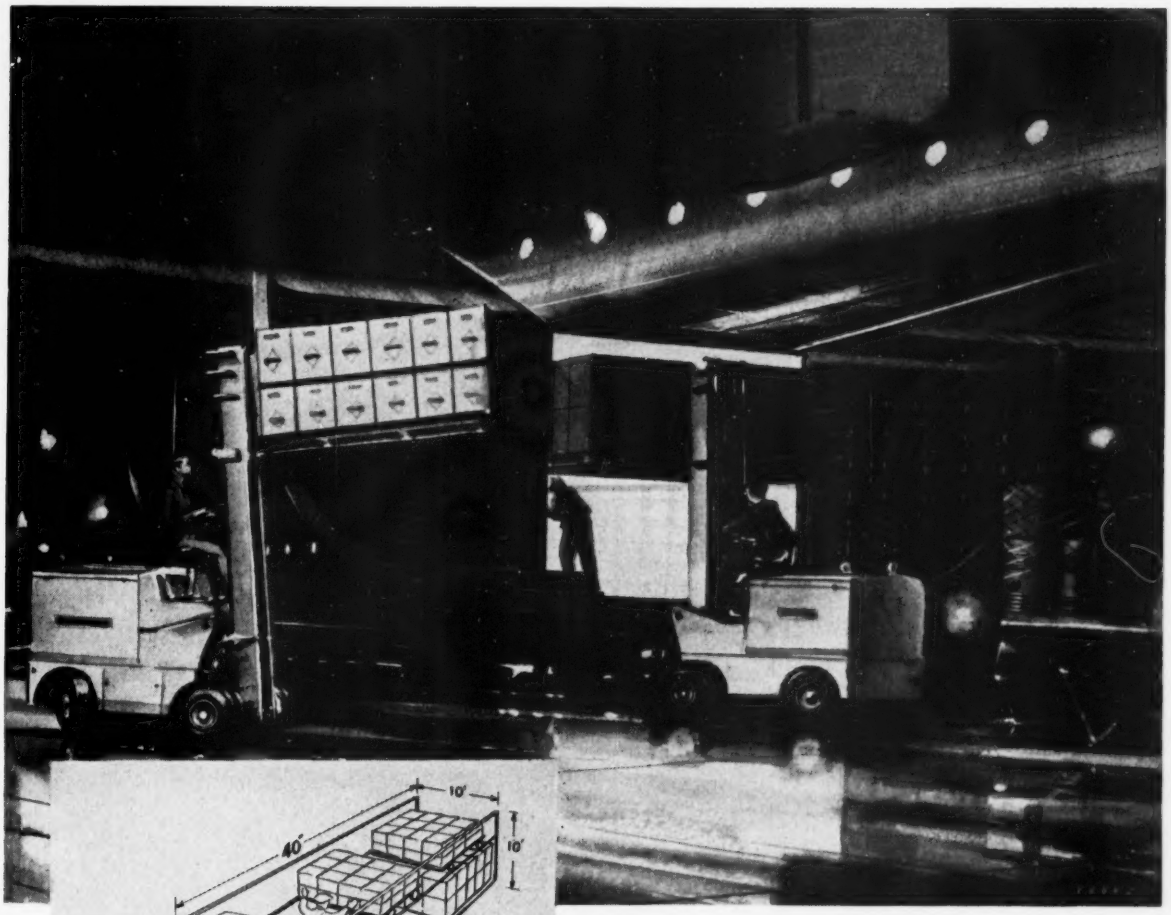

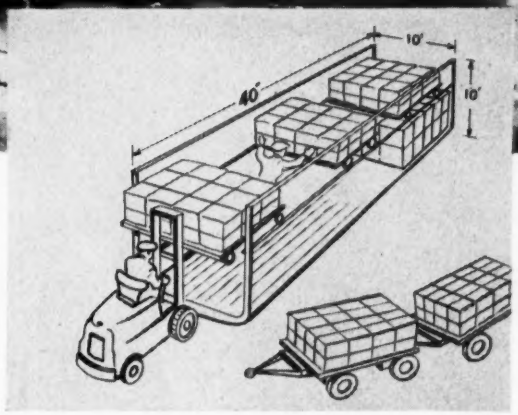

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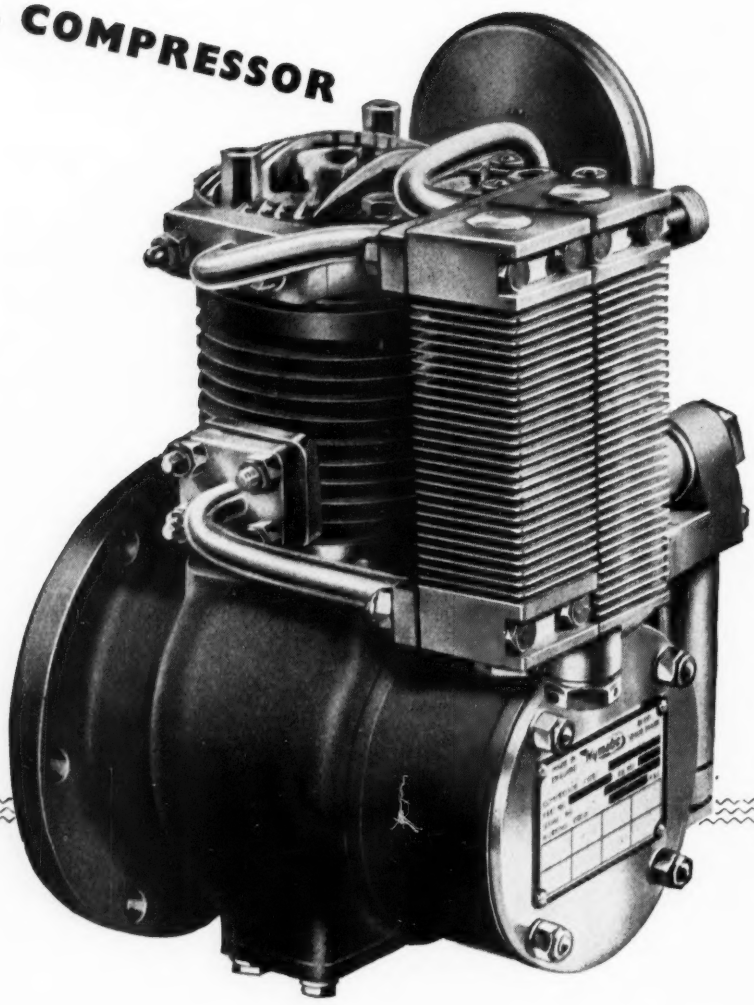

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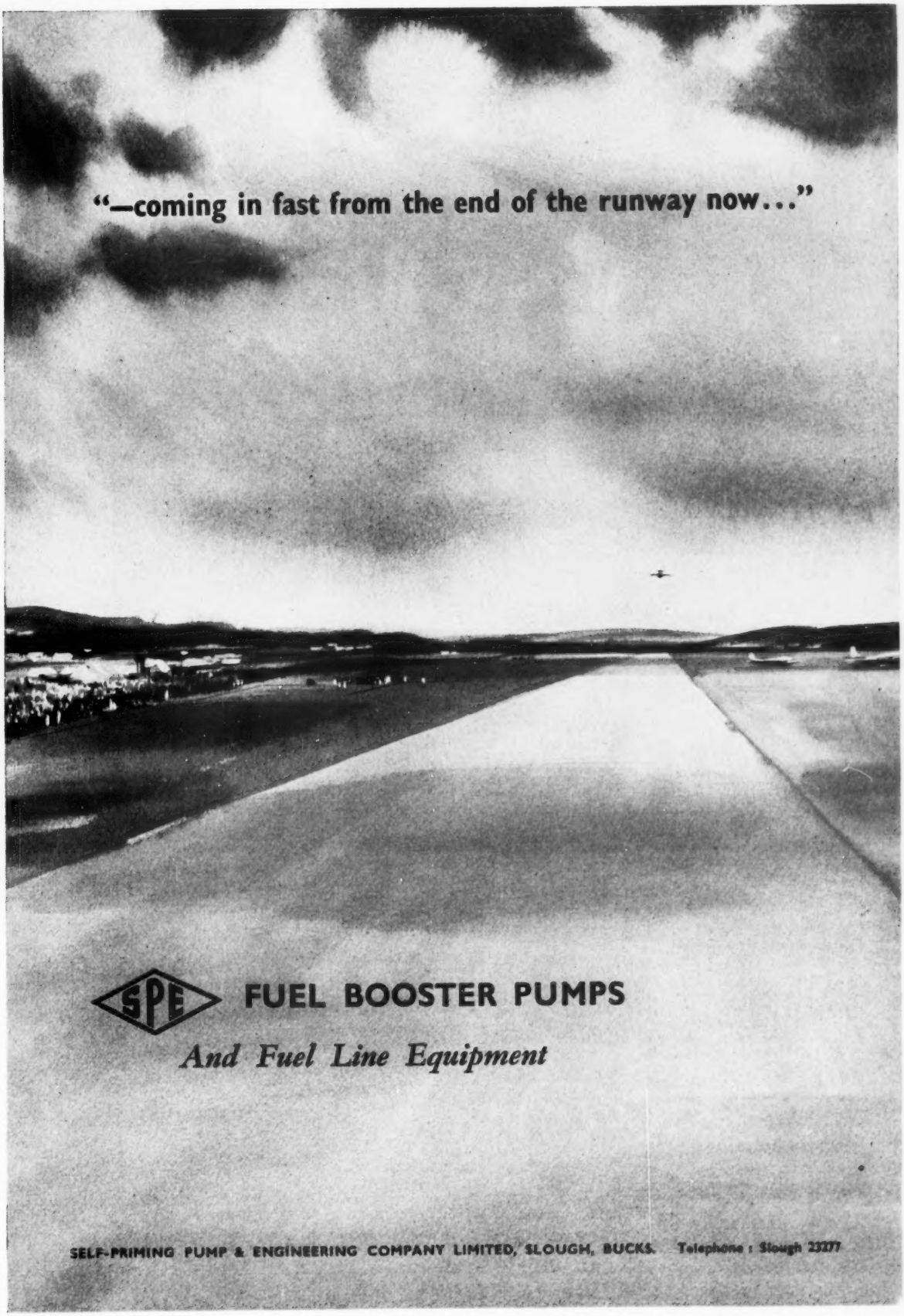
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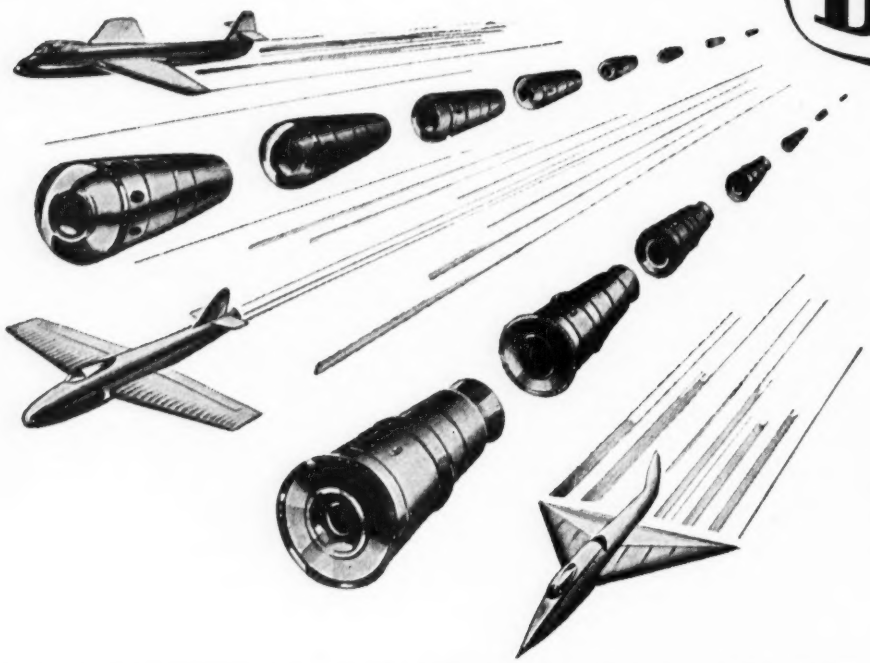

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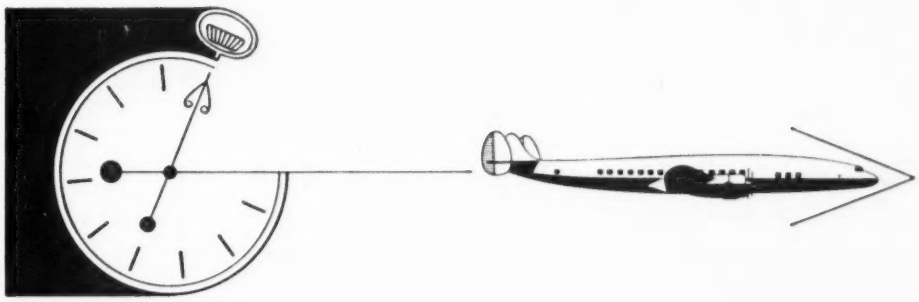

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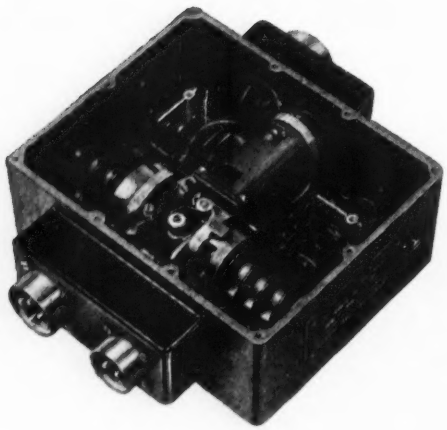

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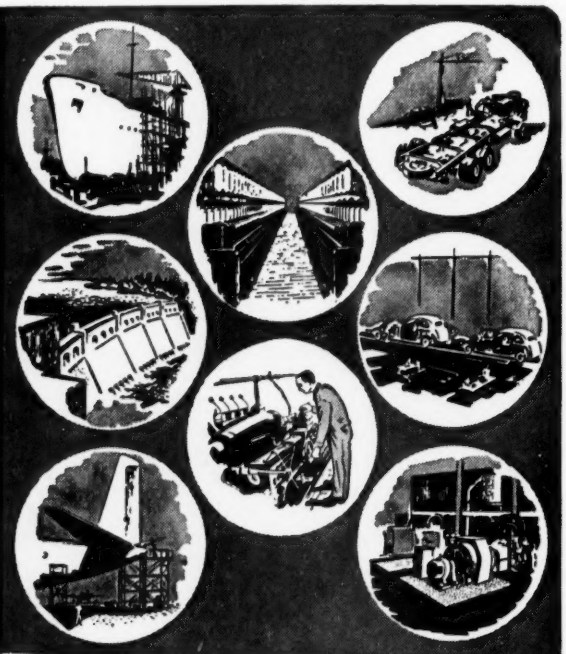

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First Aeronautical Weekly in the World

Founded 1909

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New Opportunities for Cranwell

THE Press accorded to the announcement of the R.A.F.'s plan for scholarships to Cranwell has been neither wildly enthusiastic nor particularly critical. Whether the merely factual reporting of the details indicates disinterest or disappointment with the scheme itself we do not know, though any scheme in which the Treasury has had a direct or indirect hand tends to be a dreary one. Our own opinion is that this scholarship plan—any such plan, in fact—is to be welcomed.

There is no doubt that the Royal Air Force College has had a good deal to do with the training and character-moulding of the majority of the Service's best officers and there is every reason to be anxious if the numbers for an entry fall short or the quality of new intakes is in any way below the traditionally high standard. It is also right and sensible to bring the opportunities within reach of as broad a selection of young men of good upbringing as is reasonably possible.

We and others have over a long period advocated making early appeals to boys while at school in order to ensure that at least a proportion of the best type of young men have the attractions of an Air Force career brought fully to their notice. Moreover, it had not escaped our notice that hitherto the R.A.F. was at a disadvantage by comparison with the other two Services which have their Dartmouth and Welbeck.

Under the new scheme some financial aid is offered to parents to enable their sons to remain longer at school and thus to become better material for entry to Cranwell. Cranwell's total intake is 150 cadets per annum at the rate of 50 per term. The scheme is explained on page 715.

The method of providing the limited aid—according to a sliding-scale and based on a parental means-test, may appear both elaborate and unattractive. We would not like to think that the R.A.F.'s estimate of the value of 60 picked cadets—the number visualized under the new scheme—was only £9,000 a year. It seems, however, that the precedents of long standing for this kind of scholarship are several, and that they react possibly to the disadvantage of the new R.A.F. scheme. To offer anything more magnanimous would be to upset the balance with parallel schemes for the Army and Navy and various civilian seats of learning. We may add that the year's course for each pilot at the Empire Test Pilots' School must cost over £10,000.

To judge by reports from headmasters, the grants are regarded as quite realistic and generous by comparison with those of some local educational authorities. Application forms for many scholarships, apparently, carry three or four pages of questions to the parent, of a confidential and personal nature; they include requests for a detailed account of his income, his wife's income, his mortgages, life insurance and annuities, and even whether his wife is living with him. The R.A.F. form must, it seems, follow suit.

As we have noted, the grants vary according to income. A man whose net income is between £1,300 and £1,500—a man with over £2,000 a year coming in, in fact—would be awarded £30 + 60 per cent. of tuition fees up to £100—call the maximum £130 per annum and the minimum £30. For the not-so-well-off parent earning a net income of less than £700—a £900-a-year man, say—£50 plus the whole of the £100 might be awarded, giving a maximum of £150. Thus for 60 pupils the difference between the minimum and maximum cost of the scheme to the country appears to be 60 × £120, or £7,200 p.a. One would have thought that when a sum of this minitude was involved (and certainly in practice it would work out at less) a gesture might have been made, and administrative costs saved, by abandoning the niggling sliding-scale means-test and making a simple grant to any parent of a promising son who managed to pass the aptitude, flying, medical and selection boards.

But, as we have said, the idea of an R.A.F. scholarship scheme is a good one, however devised and applied; already we learn, telephone enquiries are being received. It has the incidental virtue, too, of helping a little the educational establishments whose necessarily high fees have resulted in promising boys having to leave school at an early age to the disadvantage of the boy and the school. Good British schools, well-founded, well staffed and well equipped, are among the nation's more valuable assets. And for the "Scientific Service," the best place for its future senior-officer material until the age of eighteen years is at a good school.

FROM ALL QUARTERS

Royal Tour Departure

LAST Monday evening, at 9.01, Her Majesty the Queen and H.R.H. the Duke of Edinburgh left London Airport in a B.O.A.C. Stratocruiser on the first stage of their world tour. At the airport to bid them farewell were Queen Elizabeth the Queen Mother, Princess Margaret, and other members of the Royal Family, together with members of the Government—headed by Sir Winston Churchill—and Commonwealth representatives.

Weather was good for a northerly routeing across the Atlantic, the first to be made by air by a British monarch. Flying at 18,000ft for most of the time, *Canopus* landed at Gander at 0653 G.M.T., 22 minutes ahead of schedule, after a journey of 9 hr 52 min. Just before take-off for Bermuda at 0827, the Queen and the Duke appeared for a few moments at the door of the aircraft. The flight plan to Kindley Field showed an E.T.A. of 1400 hr G.M.T.

Among members of the Household flying with Her Majesty were A. Cdre. Sir Edward Fielden, Captain of the Queen's Flight, and Lt-Cdr. Michael Parker, the Duke's private secretary. They travelled in the rear cabin. The Queen and the Duke occupied the forward cabin, the arrangements of which had been modified, and couches were provided for them on the port side, roughly amidships. The Duke visited the cockpit during the crossing but did not take over the controls.

The aircraft, G-AKGK *Canopus*, was flown by a crew of 11 (see accompanying photograph) commanded by Capt. A. C. Loraine, who has 164 Atlantic crossings and 14,300 flying hours to his credit. In reserve was another Stratocruiser, G-AKGH *Caledonia*, with Capt. D. Anderson in command of a full crew.

Canopus was due to fly to Montego Bay, Jamaica, from Gander, Newfoundland, *via* Bermuda, where a day was to be spent in official visits. The total flying distance of 4,770 miles was to be covered in 42 hours, including the stay in Bermuda. Ships of the Royal Navy and Royal Canadian Navy were stationed along the route, keeping constant radio watch during the flight, and R.C.A.F. aircraft escorted *Canopus* on the last 900 miles of the crossing to Gander and thence to Bermuda.

A considerable portion of the tour, especially in New Zealand and Australia, will be made by air, and for this purpose the R.N.Z.A.F. and the R.A.A.F. have each formed a special Queen's Flight. Commonwealth air-transport companies also will carry the royal party on a number of journeys. Altogether they will cover 10,000 miles by air in Australia alone, and will travel in Dakotas, Skymasters and a Heron. It is at the Queen's own request that such considerable use is being made of air transport during the tour.

The Duke as R.A.F.A. President

THE Royal Air Forces Association announces that Marshal of the R.A.F. the Duke of Edinburgh has graciously consented to become its president, with effect from June 12th-13th, the date of its next annual conference. Marshal of the R.A.F. Lord Tedder, elected vice-president last June, will be senior vice-president during the Duke's term of office.

A New Swift

MANY months ago it was already clear that the Supermarine Swift was certain to become a "second Spitfire" in that it would be developed through a number of marks for widely varying purposes. The first four marks are fighters; their detail differences were listed on p. 478 of our issue of October 2nd last. Now the first fighter/reconnaissance mark can be mentioned: it is designated the Swift FR.5.

The FR.5 is basically similar to the F.4, with the exception of the nose. This is longer and of slightly different profile, and houses the camera installation and other equipment. The prototype FR.5 has already completed its initial flight trials.

N.Z. Race Navigation

MEMBERS of the Institute of Navigation, meeting in the lecture-hall of the Royal Geographic Society last Friday, heard a first-hand account of the New Zealand Race when papers were read by two of the R.A.F. Canberra pilots and the chief navigator of the R.A.F. entry. The lecturers were W/C. L. M. Hodges, leader of the flight and pilot of the P.R.7; his navigator, S/L. R. Currie, and the winning pilot, F/L. R. L. E. Burton.

Summing-up the lessons of the race, W/C. Hodges said it had further shown the potentialities of high-speed jet travel, and that within ten years a 24 hr trip to New Zealand might be commonplace. From a military angle, it had shown the flexibility of jets in an emergency. In the six months of preparation, and in the race itself, they had explored the range and speed characteristics of the Canberra to a degree which might have taken 18 months to two years under normal squadron service conditions. No serious navigational difficulties had arisen, and the R.A.F. performance said much for the soundness of the basic navigational training in the Service.

We hope to summarize the papers in our next week's issue.

New A.B.A.C. Trophy Awarded

THE first presentation of a cup donated by Mr. A. T. Lennox-Boyd, M.P., for competition between this country's flying clubs was made at the Waldorf Hotel, London, on Friday last.

The occasion was the annual dinner of the Association of British Aero Clubs and Centres, when the "most efficient club"—and therefore the prize-winner—proved to be the Southend Municipal Flying School.

Deputizing for the Minister in proposing the health of the A.B.A.C. was Mr. John Profumo, M.P., parliamentary secretary to the M.T.C.A., who congratulated the association on the progress it had made, in spite of difficulties. He then quoted figures from the report of the association; flying membership was 5,300, and non-flying membership 6,100, compared with 4,600 and 4,000 respectively in 1950. During 1952, a total of 414 Private Pilots' Licences were issued, and 734 renewed.

The clubs' most important contribution, he continued, lay in their encouragement of individualism, enterprise, courage and initiative in members. Mr. Profumo then handed to Lord Runciman Mr. Lennox-Boyd's trophy, which was to be awarded annually to the most efficient club, and concluded by suggesting the thought of a Commonwealth association of aero clubs.

Viscount Runciman of Doxford, president of the association, said in his reply that the aim of the Association remained that of helping the clubs as much as possible. Turning to the Lennox-Boyd cup, Lord Runciman described the basis of the judging (which has been performed jointly by A.B.A.C. and M.T.C.A. officials). Sixty per cent of the marks were awarded for the clubs' actual flying, 20 per cent for administration, and 20 per cent for individual qualifications such as the extent of work in connection with the A.T.C. After much thought, the Committee had awarded the trophy to the Southend Flying School, with the Liverpool and Blackpool clubs second and third.

Lord Runciman then presented the trophy to Mr. Bernard Collins, manager of the Southend School.

Mr. B. L. Bathurst, listed as chairman of the association, began his toast to "The Guests" by explaining that, as from that afternoon, Mr. Eustace Miles had taken over this appointment. He went on to speak well of all the guests present, including one from the M.T.C.A., who had managed to include

THE ROYAL FLIGHT: Crew of the B.O.A.C. Stratocruiser "Canopus," in which H.M. the Queen flew to Jamaica (see news-item above). Left to right: Capt. A. C. Loraine, Capt. R. A. Callander, 1st/Off. J. E. Willett, Nav/Off. J. D. Elliott, R/Off. C. H. P. Phillips, Eng/Off. E. O. Draper, Eng/Off. R. Skepelhorn, Stewards R. L. Dunkley, J. Jarvis, M. J. Heath and Stewardess J. Rolandi.

"minus two hundred divided by the square root of the members" in a suggested formula for club efficiency.

Replying for the guests, Mr. George Ward, M.P., Under-Secretary of State for Air, emphasized that for those who wanted pure flying, and not the mere mastery of mechanical devices (required on modern high-performance machines) the clubs satisfied a most important need.

A final speech was made, in French, by M. Champelauvier, of the Fédération Nationale Aéronautique de France, who emphasized the need for co-operation between the aero clubs of Britain and France, and expressed his belief in the future of the helicopter.

Auto-Ejection Trials

IT was disclosed last week that, during September, the Martin-Baker and Irving companies carried out a series of trials which showed that a great deal of progress has been made in the inter-related techniques of ejector seat and parachute operation. The equipment employed consisted of the Martin-Baker automatic MB.2E seat and the standard Irving 24ft canopy.

As in earlier tests a Meteor T.7 was used, based at Chalgrove, Oxon. No live drops were attempted, but dummies were successfully ejected at a height of only 200ft and a speed of 600 m.p.h., and in every case the canopy brought the dummy down to the steady rate of descent before reaching the ground.

From these results, say Irvings, it can be deduced that their parachutes can safely be used with the fully automatic Martin-Baker seats at all subsonic aircraft speeds likely to be met with in the near future.

A Civil Pilot's Courage

A STORY of courage and resourcefulness displayed by a civil pilot in Australia was revealed last week in the *London Gazette* by the announcement of the award of the George Medal to Clarence Robert Hibbert, senior examiner of airmen, Commonwealth Department of Civil Aviation. The citation states that Mr. Hibbert was the captain of a Drover aircraft *en route* from Wewak to Momote Airfield, Manus Island. It continues:

"Over the Bismarck Sea part of the propeller on the port engine became detached and pierced the pilot's cockpit, smashing Hibbert's left foot and causing the subsequent failure of the remaining two engines.

"In spite of his injuries, Hibbert immediately brought the aircraft under control and transmitted the distress signal. Realizing that he was physically unable to continue to pilot the machine he directed that he be removed from the cockpit and replaced at the controls by a qualified pilot who was a passenger in the aircraft. He then attempted to transmit further distress signals. When it became apparent that the machine would come down in the sea, he went to the rear of the aircraft to make the vital preparations for this emergency, and it was largely due to his efforts that the dinghy and its associated life-saving equipment were successfully launched.

"After the occupants had transferred to the dinghy, Hibbert, although in great pain and weak from the loss of blood, continued to discharge his responsibilities as captain and was primarily responsible for the successful assembly and use of the emergency radio transmitter . . .

"Throughout the whole operation Hibbert displayed qualities of leadership . . . in keeping with the highest tradition of service in the air."

Another examiner who was on board the Drover, Mr. Thomas Peel Drury, receives the Queen's Commendation for his actions after the aircraft ditched.

Brazil and Aircraft Imports

NEW exchange regulations, now in force, will have a bearing on aircraft imports into Brazil. From our correspondent in that country comes a note on the new system. Exchange available for imports, he says, is spread over five categories of merchandise and sold by auction on the various stock exchanges. Registered firms bid the premium they are prepared to pay on the official rate of exchange and, if successful, receive a promissory note. This entitles them to an import licence, and any authorized bank will then furnish the corresponding exchange cover against payment at the official rate.

Category 1 imports, to which 50 per cent of the exchange is allotted and for which the minimum premium is 10 cruzeiros per dollar (or the equivalent in other currencies) include aircraft engines and accessories; aviation spirit and lubricants; and aircraft radio equipment.

Category 3 imports, for which 15 per cent of the exchange is reserved and for which the minimum premium is 15 cruzeiros, include: radar apparatus; electric lighting equipment for aircraft; pulverizing and spraying apparatus; and pneumatic tyres and tubes for aircraft.

Wholesale DC-3 Conversion

ALSO arising out of Brazil's foreign exchange situation, an interesting proposal is afoot for large-scale conversion of DC-3s to Super DC-3s. The Director of Aeronautical Supplies, reports our correspondent, has said that the quota allotted to imports of complete aircraft will be entirely absorbed in the purchase of modern equipment for international lines, leaving nothing for renewals to domestic fleets. It is therefore proposed to convert no fewer than 300 DC-3s and C-47s, provided that the Air Ministry will cede plant and labour while the operators obtain from the United States the necessary components. These will consist of P. and W. R2000-13 engines, and undercarriages, wings and airscrews. It is stated that conversion will cost £40,000 per aircraft, as against £320,000 for a replacement such as the 44-seat Convair. [Douglas quote £100,000 for conversion.]

Our correspondent adds that the Export-Import Bank, Washington, has granted a credit of 3,110,000 U.S. dollars to the Lockheed Aircraft Corporation towards the supply of three Super Constellations to Viacao Aerea Riograndense. The loan will be amortized by monthly payments over four years, beginning in March 1955, with interest at 4½ per cent per annum. The Bank of Brazil has authorized a loan of 60 million cruzeiros (£1,200,000) to Panair do Brasil to enable that company to acquire four Comets for its international routes. The total cost exceeds 160 million cruzeiros.

SCOTTISH SEND-OFF: At the formal opening of the Rolls-Royce East Kilbride factory, described on page 693. Top table, l. to r.: Mr. W. A. Robotham (director R-R); Air Chief Marshal Sir John W. Baker; Rear-Admiral Caspar John; Mr. Duncan Sandys; and Lord Hives.

History and Herr Messerschmitt

WILLY MESSERSCHMITT, the former designer of German aircraft, recently discussed his Me262 twin-engined fighter with American journalists. After saying that his firm built "600 to 800" of these aircraft, he went on to claim that the Me262 was the only jet fighter to see action in World War II and that it reached 640 m.p.h. in horizontal flight at sea level in 1945.

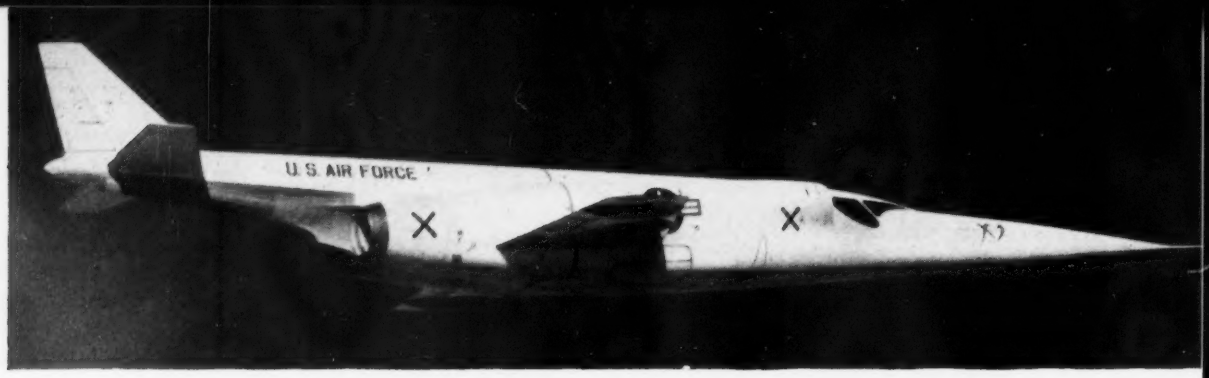
Assuming these statements to have been accurately quoted, they are, to say the least, open to question. It is odd that Herr Messerschmitt should not remember within 200 aircraft how many 262s were built. Again, he cannot claim that no other jet fighter saw action in the 1939-45 period; the Gloster Meteor was standard equipment in a number of squadrons from 1944 onwards and these operated from Britain and the Continent, destroying many flying bombs and piloted aircraft. As for the 640 m.p.h. figure, we would like to see the German designer going into a little more detail on how the speed was achieved; after protracted testing in this country the maximum speed of the Me262 was found to be 517-520 m.p.h.

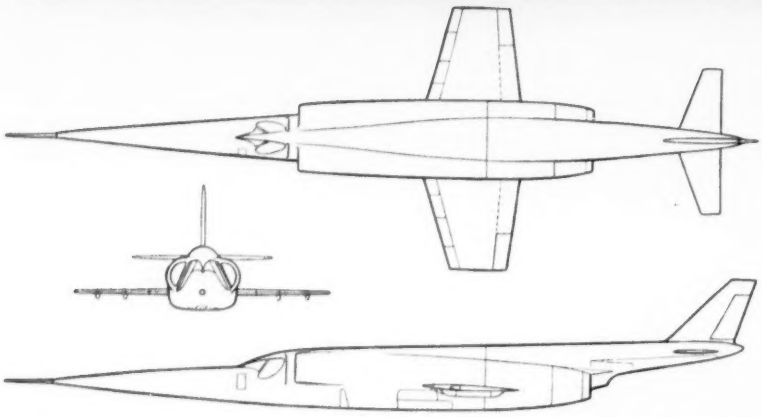
The Extraordinary X-3

WHEN the photographs reproduced overleaf came into our office we recalled the country bumpkin who, confronted with a giraffe for the first time, exclaimed "I don't believe it." We have watched the Douglas X-3 progress from the original project of 1947, through many variations, right up to this form—which is by no means final. And yet, prepared as we were, the knowledge that the X-3 has actually been built, and flown by a human pilot, comes as a shock and as an unpleasant reminder of this country's lack of attempts at research in comparable fields.

In our survey of the work of the Douglas D.558-2 Skyrocket (*Flight*, May 9th, 1952) we quoted the pilot principally concerned—Bill Bridgeman—as pleading for a "genuine" supersonic aircraft capable of keeping above Mach 1 for a time measured in minutes, not seconds. He also asked for a true supersonic wing-section, adequate irreversible controls (and, perhaps, a yaw damper) and an efficient cockpit-conditioning system.

Fulfilling these requirements the Douglas X-3 is the outcome of a joint programme by the U.S.A.F. Air Research and Development Command, assisted by the N.A.C.A. and U.S. Navy, with Douglas, Santa Monica, as the sole contractor. It may be noted that the Skyrocket was a Douglas/Navy development. The X-3 grew out of a Navy contract of 1947 calling for a research air-





THE X-3 is white-painted, as are all N.A.C.A. research machines. Though all-up weight exceeds that of the DC-3, span is less than that of a DC-3 tailplane. The illustration below depicts the Douglas crew preparing the X-3 at Edwards A.F.B. Boundary-layer slots are visible just forward of the main intakes; the air extracted probably passes out around the jet nozzles. The needle nose carries several pitot/static and yaw-sensing heads.

DOUGLAS X-3

Two Westinghouse J34 turbojets of 4,500 lb thrust each. Span, 22ft 8in; length, 66ft 9in; height, 12ft 6in; all-up weight, over 27,000 lb; design speed, Mach 3 (representing from 1,960 to 2,280 m.p.h., depending on height); design altitude, 200,000 to 300,000ft.

FROM ALL QUARTERS . . .

craft capable of Mach 3. Remembering how little was known of such speeds in those days it is doubtful if the contract specified anything else.

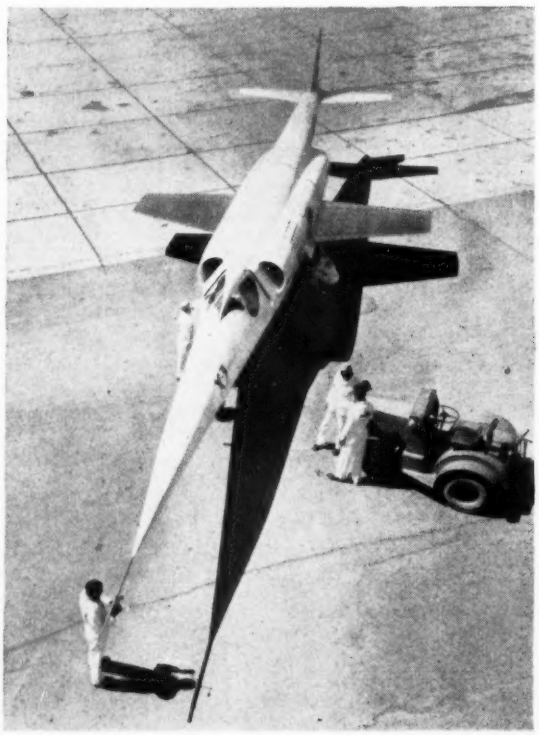
Over 60 possible combinations of turbojet, ramjet and rocket power unit were studied. It is nothing short of extraordinary that the power of the X-3 is derived solely from a pair of afterburning Westinghouse J34 turbojets of but 9,000 lb total thrust. Rockets, will, we hear, be added later. The X-3 has a small, conventional fin and rudder; single movable horizontal tail surface; conventional ailerons; "droop-snoot" wing leading-edge; and split flaps. The wing is, of course, sharp-edged and stubby—and unswept, for there is little to be gained and much to be lost by introducing sweep-back for a Mach number of three.

Altogether the control system of the X-3 is surprisingly conventional—far more so than those of such aircraft as the F-100 and F-103, although the latter are much better-looking. As the X-3's wing loading at full load works out to at least 200 lb/sq ft, the wing must be completely solid, apart from a small spanwise channel for control runs. All controls are clearly fully powered and irreversible. The leading edge and ailerons are hinged from external brackets which result in long under-wing fairings. Airframe materials consist almost exclusively of stainless steel, titanium alloys and K-Monel alloy, all of which retain their strength at the temperatures produced by skin friction—which we estimate to reach 1,500 deg F at sea level, falling to 500 deg F at 200,000ft. We know that an air-conditioning system of unusual capacity is fitted, although the pilot of the X-3 always wears a full-pressure suit.

The pilot sits in a slightly reclining position on the port side of the small cockpit. Unless the entire nose is removable for the purpose, he enters *via* the nosewheel door. Under the intakes are what appear to be fan-type air brakes, of a design similar to those of the SAAB J 29. Directly under the wing, the flat-bottom of the fuselage is apparently formed by a huge air brake almost identical in shape to that of the F-100 (*Flight*, November 6th). Within the fuselage is housed 1,200 lb of experimental equipment, some of which is linked with the pressure-sensing holes scattered over the airframe, of which there are some 850. Nearly all the equipment carried was specially developed by the N.A.C.A.

For over a year the X-3 has been operated from Edwards A.F.B., California. With a take-off run of 15,000ft the X-3 cannot take off from any other airfield.

The X-3 has carried out some impressive flights but, without rockets, cannot have approached the limits given in the table above. With a razor-edge wing, even allowing for the drooping leading and trailing edges, the maximum lift coefficient cannot be high; assuming an empty weight of some 15,000 lb, the landing speed inevitably works out to over 200 m.p.h.



Australian Firefly Trainer

NOW undergoing final full-load, Ratog and armament trials by the Royal Australian Navy is the protoype of an interesting Firefly AS.5 conversion undertaken by Fairey Aviation of Australia. Outwardly distinguished by having two stepped cockpits, the new variant is suitable for dual instruction, tactical training, gunnery and rocket work, bombing, deck-landing and catapulting, and night flying.

Very considerable re-working has been necessary, and this has been carried out by a design-team under L. C. Williams, engineering manager, R. A. Manuel, chief technician, and L. C. Pitt, experimental D.O. head. The Firefly T.5 is the first aircraft engineered by this branch of the company.

ROLLS-ROYCE EXPANSION

East Kilbride Factory Formally Opened by Minister of Supply

ON Friday last the Rolls-Royce factory at East Kilbride, near Glasgow, was formally opened by the Minister of Supply, Mr. Duncan Sandys. Many distinguished guests were present, including the Earl of Home, Minister of State for Scotland; Sir Patrick Dolan, chairman of the East Kilbride Development Corporation; Air Chief Marshal Sir John Baker, Controller of Supplies (Air), M.O.S., and Rear-Admiral Caspar John, Deputy Controller of Supplies (Air), M.O.S.

A tour of the shops was followed by a second ceremony in which the Minister, from a control panel at East Kilbride, started up an Avon engine at the test-plant 2½ miles distant. Sound and vision were relayed back to East Kilbride.

In welcoming the guests at luncheon, Lord Hives (chairman, Rolls-Royce, Ltd.) said that when, at the beginning of the Korean war, the company was asked to expand production facilities, they had no hesitation in saying that the expansion should be in Scotland. During the war, 25,000 Merlin engines had been built in the Glasgow area, and an even greater number had been overhauled and sent back in service. Since the war, the company had always employed more than 4,000 people in the area.

In proposing the toast of "East Kilbride," Mr. Duncan Sandys said that in his capacity as "landlord of the factory," he could think of no more desirable tenant than Lord Hives. He also said that great things were expected of the by-pass principle incorporated in the Conway engine, in increasing range and reducing operating costs by saving in fuel consumption.

In due course, presumably, the Conway will be among the engines manufactured at East Kilbride. The works, which is already in production, is at present handling Avons and Derwents.

The factory consists of four main blocks (machining, assembly, process-plant and stores) separated by roads; behind these are a receiving block and the boiler-house, and in front, facing the main road to Glasgow, is a two-storey office building. A canteen and welfare-hall occupy a separate island site.

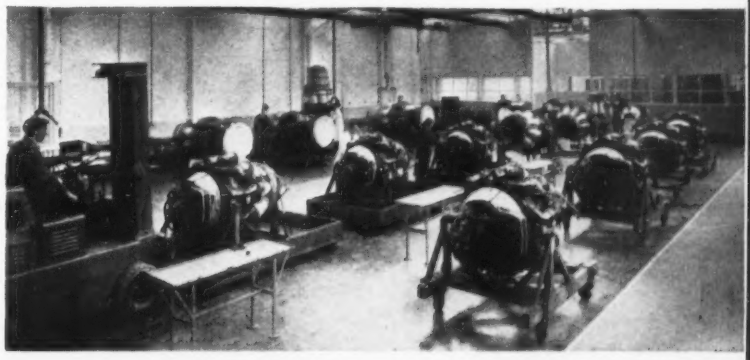
Machine-shop equipment comprises a variety of modern general- and special-purpose tools capable of high-precision work on components ranging from small studs to compressor-shafts machined from forgings weighing 4½ cwt each. In the assembly and repair block, engine sub-assemblies are built up separately and then passed to the erecting line, extensive use being made of specially designed stands. Rebuilding of repaired engines is handled on similar lines, and in this section there are very complete facilities for stripping-down, degreasing, and crack-testing of parts before they are passed to the inspection bays for visual examination. At the output end of the assembly block are facilities for inhibiting and preparing engines for despatch.

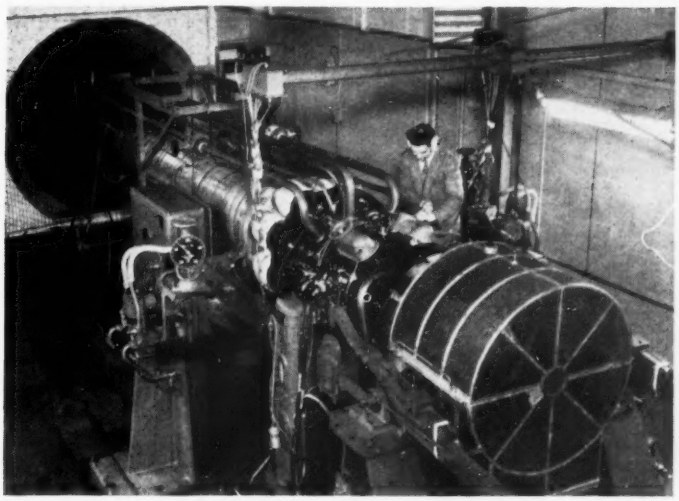
The process block houses a range of hardening and tempering furnaces and a new type of gas-carburizing plant which overcomes the familiar problems of scaling. In this section, too, is a plating shop, equipped to carry out a dozen protective and other processes under the control of an adjoining laboratory.

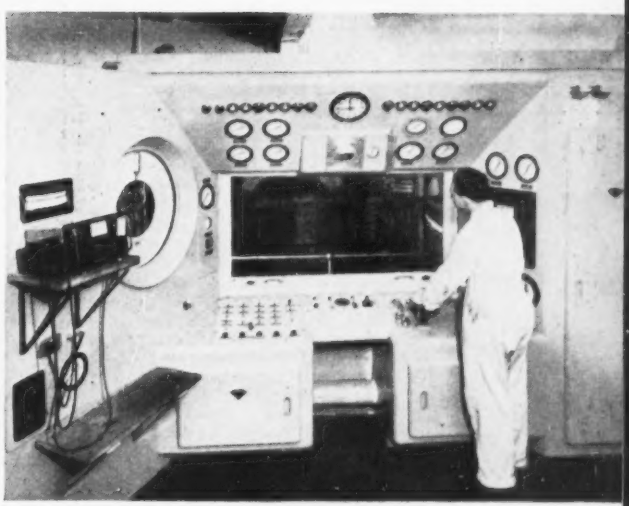
Also in the process block is the tool-room, equipped with P. and W. and Oerlikon jig-bores and other precision equipment, and in the adjoining standards room the atmosphere is controlled for both temperature and humidity.

A notable feature of the overall layout is the installation of a dragline conveyor, consisting of a chain moving below floor-level and carrying attachments which, projecting through a slot, enable trucks to be quickly coupled to the chain. This conveyor is used for the issue of materials to machine and process departments, the transport of part-machined components between blocks, and the transportation of finished parts to the stores. Where it enters or leaves blocks there are automatic air-lock doors which permit passage of the trucks while preventing cold air or dust from entering the shop interiors. A routeing device enables the various destinations of the trucks to be preselected.

Though the test-site is sufficiently far from East Kilbride to avoid disturbance to residents, particularly effective silencing equipment is installed at the test-houses.

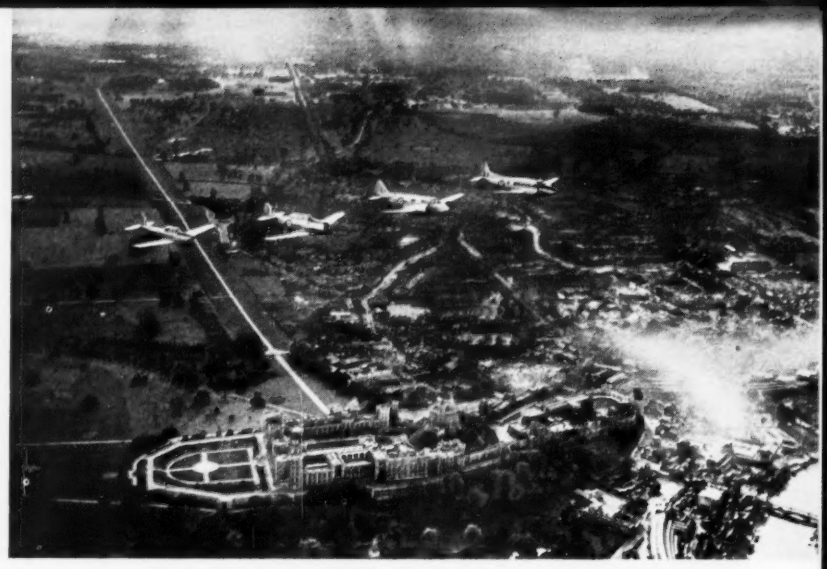






(Right) Repaired Derwents and—in background—Avons being prepared for despatch. (Below) An Avon in the test-house, the control-room of which is also shown; main items are by Heenan and Froude, Ltd.

HERE AND THERE



ROYAL CHRISTMAS-CARD: This fine aerial view has been prepared for the Duke of Edinburgh. Specially flown for it over Windsor Castle were the four types on which His Royal Highness has learned to fly—Chipmunk, Harvard, Oxford and Dove.

Faster—

THE R.Ae.C. announced last week that Lt.-Cdr. Lithgow's world speed record in the Vickers-Supermarine Swift F.4 on September 25th has been confirmed by the F.A.I. at 1,184 km/hr (735.7 m.p.h.) The provisional figure was 737.3 m.p.h., and the reduced speed is the result of re-calibration of the timing apparatus on return to this country. Lt.-Cdr. Verdin's 753.4 m.p.h. in the Douglas F4D Skyray on October 3rd still awaits confirmation. Two N.Z. race records by Canberras are also confirmed.

—and Faster

FLYING the Douglas D.558-2 Skyrocket after release from a B-29 at 32,000ft on November 20th, Douglas test pilot Scott Crossfield attained a height of 60,000ft and, in the subsequent dive, a speed of 1,327 m.p.h., equivalent to just over Mach 2. His 28,000ft climb took three minutes and consumed three tons of rocket fuel. These figures were announced last week by the N.A.C.A. The same pilot flew the Skyrocket at 1,272 m.p.h. on October 14th. High-altitude speed flights of this kind are not eligible for F.A.I. recognition as records.

Venezuelan Jets

FROM Venezuela it is learned that Rolls-Royce are shortly to open a large overhaul base at Caracas. It is also understood that a further order for Canberras is likely to follow the delivery, now completed, of six of these machines. The Venezuelan Air Force are also operating some twenty Vampires. L.A.V.'s Comet 2s are due for delivery early in the New Year.

Another Export Rise

FOR the fifth time this year, British aviation exports in September—figures for which are now available—exceeded £5m in value. The total for the first nine months of the year was some £49m, an increase of £5m on last year's figure; on average, this represents an annual rate of £65m. The industry's labour force continues to rise at about 2,000 a month; in August, the latest month for which figures are available, the total was 221,600—not including those engaged on accessory and sub-contract work.

Belgian D.F.C.s Foregather

THIRTY-SIX of the 47 active members of the D.F.C. Club of Belgium attended the recent dinner held at Melsbroek Airport, Brussels. The club's members, all of Belgian nationality and holders of the D.F.C. and other British awards, meet three times a year, the reunions being organized in turn by the three membership groups—those who remained in the Belgian Air Force, those who joined Sabena (Belgian Air Lines) and those who entered other civil occupations. The Melsbroek dinner was organized by the Sabena group, and the news of it reaches us from Captain L. W. Thorne, D.F.C., G.M., who, as an Englishman flying for Sabena, is an honorary member.

Jubilee Celebration

THE joint R.Ae.S.-R.Ae.C. dinner to celebrate the 50th anniversary of powered controlled flight, to be held at the Dorchester, London, on December 17th, is to be followed by the first showing of a film, *The Story of the Century*. Made by Shell Film Unit in collaboration with the R.Ae.S., it depicts the growth of aviation and its impact on twentieth-century civilization. Tickets for the dinner (£3 10s. inclusive of wines) are available only to members of the R.Ae.S. and R.Ae.C. and their guests; application must be made by December 1st.

FIFTY YEARS REVIEWED

THE December 11th issue of *Flight*—a fortnight hence—will be a greatly enlarged special number in commemoration of the 50th anniversary of powered flight. Among other features it will contain what we believe to be a unique review, both in scope and in the presentation of numerous illustrations, of the development of heavier-than-air flight since the days of the Wright brothers. This supplement alone will constitute a valuable work of historical reference.

Pembroke Delivery

ON Thursday, November 19th, the first of four Percival Pembroke C.1s, ordered by the Southern Rhodesian Air Force, left Benson, Oxon. on its delivery flight. Piloted by Capt. Edward Cunnison, D.F.C., S.R.A.F., the Pembroke carried a crew of two, and five other S.R.A.F. personnel. The flight was made *via* Istres, Tunis, Fayid, Khartoum, Entebbe, Tabora, N'dola, and New Sarum Airport, Salisbury.

Hatfield to N.Z.

MR. R. W. JAMIESON, hitherto a member of the de Havilland business office at Hatfield, was due to leave England last Wednesday to take up an appointment with the New Zealand de Havilland company. A New Zealander by birth, Mr. Jamieson joined the D.H. Technical School in 1936, served as a pilot throughout the 1939/45 war, and rejoined the company in 1946 as a production test pilot. Since 1950 he has been specializing in Comet business.

Flat or Spherical?

APPARENTLY well-authenticated reports of a "flying saucer" seen over south-east England on November 3rd and tracked on A.A. radar screens were followed, on the 19th, by an Air Ministry report that a meteorological balloon released from Crawley on the date in question had flown over the area, eventually attaining a height of 57,000ft. Similar reports of strange objects over Lancashire on the 20th brought a statement from a met. officer at Ringway, Manchester, that balloons had been released that day.

Bang Off

REPLYING in the Commons last week to questions about the fall of practice bombs in and around Saltfleet, Lincs, Mr. George Ward (Under Secretary of State for Air) admitted there had been 16 such incidents between March 1952 and November 12th last. He explained that it would be wasteful to establish ranges in remote parts of Scotland or Wales in view of the distance which aircraft would have to travel from Eastern Counties bases. Most of the incidents had been caused by technical faults, and inspection was being tightened. The target near Saltfleet was being moved 700 yards southward.

Historical Literature

THE collection of rare and historic books on aeronautics accumulated over a period of many years by Lt-Col. W. Lockwood Marsh, F.R.Ae.S., is shortly to be sold by auction. It ranges from 16th-century works to an 1897-1943 set of the *Journal of the Royal Aeronautical Society* and a 1909-1948 set of *Flight*. The sale is to take place at the auction rooms of Hodgson and Co., 115 Chancery Lane, London, W.C., on Thursday, December 10th.

Lockheed Missiles

RESPONSIBLE for the design, development and production of pilotless aircraft and missiles, a new division has been established by Lockheed Aircraft. It will be headed by Elwood Quesada, a former lieutenant-general of the U.S.A.F. in charge of fighter forces in Europe and Africa during World War II. Robert Gross, the company's president, says that their work in the field of pilotless aircraft has "demonstrated such an exciting potential in the light of current military requirements" that they feel it must be speeded and expanded.

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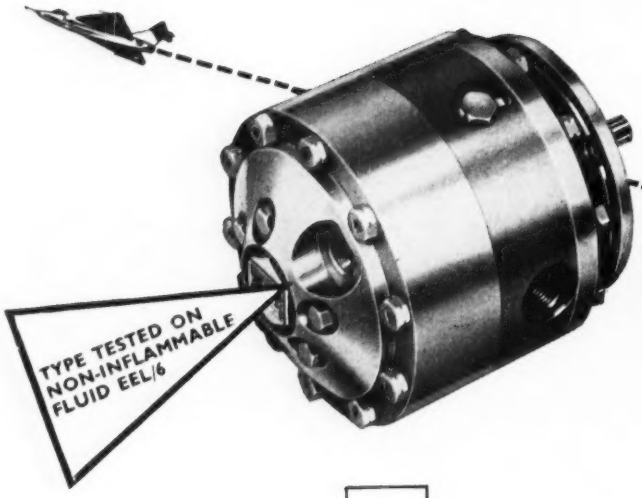

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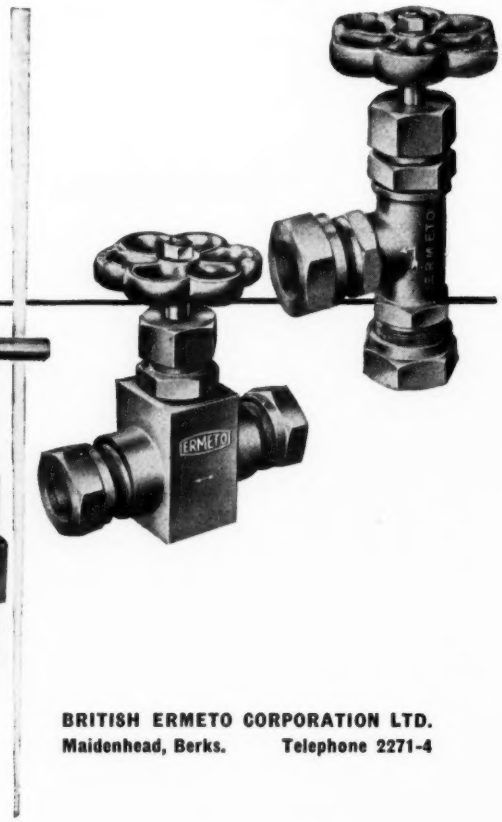

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By

FRANK BESWICK,

M.P.

"The terminal buildings were, to say the least, austere" — at Tooraweenah, a typical outback airfield.

OUTBACK AIR TRANSPORT

A Blessing to the People of Australia's Bush Country: Touring the Butler Company's Routes

I WANTED to see something of the Australian outback, where the real wealth is produced, and the rapidly developing bush air-transport services of which I had heard so much.

So, early one morning, I set out from Sydney on a DC-3 of Butler Air Transport Pty., Ltd.

The first stop was Tooraweenah. It was an exceedingly happy introduction to what I wanted to see. At "Toora" they still told the story of how Arthur Butler, the company's founder and present chairman, landed in the field there after his record-breaking flight in a Comper Swift from England to Australia; and of how, whilst Pressmen and public waited to welcome the triumphant hero at Sydney, he forgot the flight whilst he made his marriage proposal to the present Mrs. Butler.

I was told that before he took off again the ambitious young pilot promised the people of Tooraweenah that one day he would bring them the benefits of an air service. He has done just that.

The simple figures are more than interesting. Tooraweenah is about 204 miles by air from Sydney, and 353 by (very indifferent) road. Journey time by rail is 16 hours—and 27 miles to the rail-head. Our flying time was 1½ hours.

Air fare is £4 10s single, against £3 11s by rail. Return rail charges show a greater saving, though to the price of the rail ticket must be added the cost of food and sleepers. But in an area where a rabbit catcher can earn £5 to £7 a day, and a sheep shearer rather more, the little extra ticket costs are irrelevant when one saves such time.

There are some other fascinating statistics.

The population of Tooraweenah I believe to be about two or three hundreds; but the number of people coming and going at the airfield last year totalled 15,000. There are DC-3 services from Sydney on five days of the week, whilst on Mondays and Wednesdays the area supports two services in the day and a Heron helps to move the weekend traffic.

Of course they drive in from townships and sheep stations from as far as eighty miles away, but on any showing the traffic figures are remarkable. It was a similar story at the other seven or eight communities I visited, over a network of two to three thousand miles.

At Coodooga, for example, by the Queensland border, there are not more than 140 people in the settlement itself, and on the last fifty miles to this air-strip I don't suppose I saw half a dozen houses. They have a twice-weekly service. As we drove from the airfield to the village, bouncing skilfully along from crag to crag on what I understand they call a road, I asked the wife of the local Butler agent how many people wanted to travel by air from Coodooga. "Oh," she said, "I get an allocation of eight seats a week, and I try to borrow extra when I want them." As a percentage of the population—even of the shire, let alone the village

(Above) The Butler agent at Tooraweenah, Mr. Fletcher, refuels the de Havilland Heron; the pump was being manned by the crew and the author.

(Left) Passengers arriving at Coodooga — a settlement which probably provides "as high a proportion of air travellers as any community in the world."

OUTBACK AIR TRANSPORT . . .

—this must be as high a figure of air travellers as in any community in the world.

This practice of "borrowing" was, I found, highly developed. By telephone one agent would borrow from, or lend to, another down the route. It seemed efficient, delightfully personal and certainly less costly than a teleprinter seat-booking system.

I was especially interested in the ground facilities offered at these utility airfields. We have something of the same problems at home—in Scotland, for example—in providing facilities for sparse traffic at lowest cost without cutting into safety margins.

Most of the runways I saw were natural earth or part grass. At Tooraweenah, which had only just been taken over by the Department of Civil Aviation, I was introduced to a likeably keen young man in overalls who was their representative. After a week's training at another airfield, he was on six months' probation.

I asked him whose responsibility it was to see that the runways were serviceable. The young man said it was his. What if there are too many loose stones? They are rolled. Who rolls them? I do. Who operates the fire tender? I do.

One day, elsewhere, it was with the local Butler agent that I went out in a car to drive off a few cattle that had strayed on to the runway. They moved reluctantly. Too fat and contented, the agent said. Which seemed quite true, though one of the mysteries of Australia is how animals contrive to get nutriment at all from the odd wisps of dry vegetation which are all one can see for miles on some of the flat dry stretches.

It was sheer delight to meet some of these local agents. All seemed to have additional interests, of course. Most served on some public body—a member of the shire council, or maybe even as mayor of the town. They, too, turned a hand to anything on the airfield.

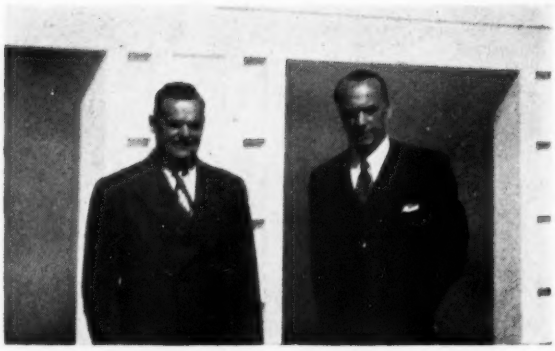
And so did the pilots when necessary. At Coonamble, for example, I found myself taking turns with the two pilots and the local agent in pumping by hand 160 gallons into the Heron.

The agent, Mr. Fletcher, apologized afterwards that I had been pressed into service. As he had served on the Reserve in the last war, and had been wounded in France in World War I, and had served Her Majesty in the South African campaigns, I cannot think any kind of apology was due from him to me.

Undoubtedly this readiness to lend a hand at anything that needs doing is one of the things that makes these services possible.

Looking still rather doubtfully, maybe, at the rough surface at Tooraweenah I asked how many accidents they had had. None, they said, excepting we once had a Dragon taxi into a ditch. The record of these companies certainly is remarkable. Ansett Airways told me they had had but one accident in 16 years and that, believe it or not, was when an aircraft collided with a railway engine—and compensation was paid to the air company.

The terminal buildings too were, to say the least, austere. Again at Tooraweenah I found two wooden hutments used for passenger reception and stores, a shelter for the fire tender, and then out to the left a sentry-box structure marked "Men" and way out over on the other side a similarly shaped structure marked "Ladies." I immediately took out my camera to photograph what I thought to be typically frugal bush facilities. At the next stop, however, the two central hutments were reduced to one; further along the route this one hutment was dispensed with and all that remained were the two boxes in splendid isolation, the sole buildings on the landscape for miles around. Later, Air Marshal R. Williams, Director-General of Civil Aviation, told me something of the development plans which he had in hand for the airfields scattered over a continent, and for which his department is responsible. Included was an item intended to make these essential passenger facilities less widely separated, and attached to some other building so that progress to their shelter was a little less remarked.



Dubbo is no one-horse town—as the Mayor, Ald. L. H. Ford, and the Town Clerk, Mr. V. Mathews, seen here, demonstrated to the author.

I must report that almost the last outback town I visited was Dubbo. I had heard of Dubbo before. It is an alternative airport for Sydney. It appears that on one occasion an aircraft with Sir Miles Thomas was diverted there. On eventually reaching Sydney he was interviewed by newspapermen and the story, as they gave it to me, was as follows.

"What do you think of Dubbo, Sir Miles?"

"Well," was the reply (and I've no doubt it was in characteristic good humour), "Dubbo is what I understand you would call a one-horse town, but I imagine that in this case the horse must have left some time ago."

This remark, duly publicized of course, made Alderman Ford, the Mayor of Dubbo, hopping mad. Words were exchanged. Suffice it to say that the Mayor was mollified.

I did in fact meet the Mayor of Dubbo (I believe, indeed, he is also Mr. Butler's local agent). He referred to this famous occasion when Sydney airport was closed-in, and over 200 international travellers found themselves seeking accommodation in the town of Dubbo (total population 11,000). With the help of the Mayor they were—ultimately—accommodated.

I have no doubt that Sir Miles would agree with me that Dubbo is fortunate in having such an energetic and zealous individual as its first citizen. Thanks to him Her Majesty will be making her one visit to the New South Wales outback at Dubbo, and when I left him the Mayor was telling the agricultural-show committeemen that they must put on a real bull-dogging and steer-throwing show for the Royal visit.

The whole point about this diversion, however, is that whilst to the regular air traveller on the international routes Dubbo must seem a rural spot, compared with the other outback places which I saw it is a veritable metropolis.

Just one word about the Butler company. Mr. Arthur Butler himself, in some pleasantries about political views, described himself as "an anti-nationalizing socialist," and claimed his company to be up-to-date socialism.

He has made it possible for the staff to take up shares, and I understand that 93 per cent of them have in fact done so. Together with their (hard) working chairman they hold 48 per cent of the issued stock. I must say that of those whom I came across all took the most lively interest in the company of which they owned a part.

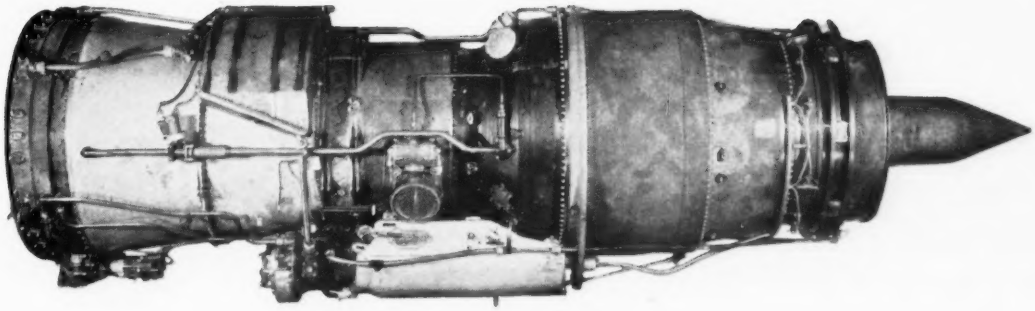
In another aspect of operations Butlers shared a problem common to many of these domestic Australian companies. Apart from one Heron (to be joined this month by a second machine) they operate DC-3s. The very important question arises as to how long these machines can continue their yeoman service, and the operators are obviously very concerned with the problem of replacements. The machine about which I had many questions was the projected Handley Page H.P.R.3.

Some observers seemed disposed to think that the small operators could not afford replacements at all. Certainly, if the cost of a new machine is to run into six figures, and it is to replace a DC-3 bought at a bargain price of around £10,000, quite new questions of capital liabilities arise.

On the other hand, one thing seems very clear to me: the growth of air travel within the Australian continent cannot now be checked. Its influence upon the development of the nation is far too profound.

Ultimately it will not be a matter of whether they can afford the most suitable new machine, but whether, from the national point of view, they can afford to do without it.

Butler Air Transport's operations manager, Capt. T. R. Young, was a recent visitor to this country. The photograph was taken when he went to Vickers-Armstrongs' Weybridge works to see the Viscount production line; with him are (left) two colleagues, Capt. E. Avery and Mr. T. Williams and (right) Mr. R. C. Handasyde, Vickers-Armstrongs' sales manager.



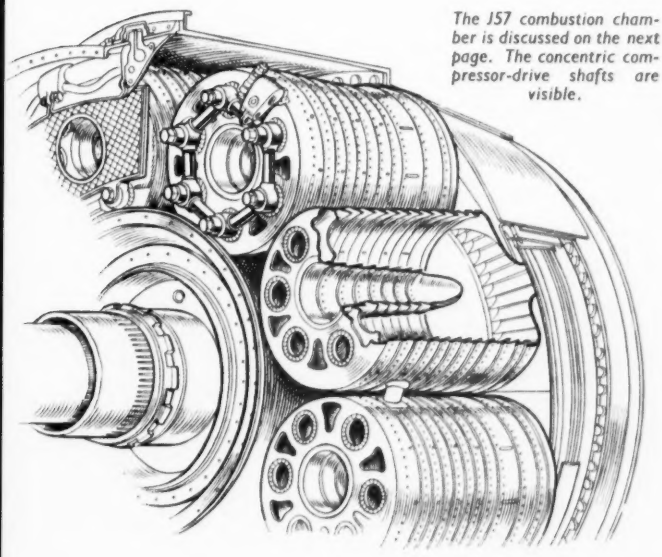
TWO-SPOOL TURBO-WASP

Characteristics of the Pratt and Whitney J57

WITH the exception of young enthusiasts who seem to have a propensity for recording complex designations, readers probably find difficulty in distinguishing one American gas turbine from another. Algebraic symbols and a complete lack of identifying names makes it all too easy for the reader to become lost in a welter of T- and J-numbers. Usually, this is of slight consequence, but the engine described here is very much an exception. The Secretary of the U.S. Air Force, Mr. Harold E. Talbott, has described it as "the Air Force's future engine." After a wait of many months, we can at last introduce this fine piece of engineering in an account which we believe is more detailed than any other to appear in this country to date.

The entry of the Pratt and Whitney Division of the United Aircraft Corporation into the gas-turbine field followed no conventional pattern. Since 1925 the company have been renowned as manufacturers of some of the best—many would say the best—aero-engines in the world. And, apart from quality, no other firm can match the Connecticut company's production potential; between 1943 and 1945, for example, Pratt and Whitney and their sub-contractors produced a potential horsepower exceeding that of all the other American manufacturers combined.

When, in 1941, this country introduced the United States to the turbojet, it was decided for several sound reasons to allocate work on the new power-plants principally to the General Electric Company. This left the established engine firms—Pratt and Whitney, Wright and others—free to maintain their colossal programme of piston-engine work, with which the war was to be won.



The J57 combustion chamber is discussed on the next page. The concentric compressor-drive shafts are visible.

At the end of hostilities, Pratt and Whitney emerged as the world's greatest manufacturer of piston engines, with unrivalled facilities both for research and production. But gas turbines are, as many were then discovering to their cost, a new kind of animal. American engineers with real gas-turbine knowledge could almost be counted on the fingers and, on reflection, it is surprising that both Pratt and Whitney and Wright fell into the trap of believing that the turboprop was easier to develop than the turbojet. In 1945 both companies started work on 5,000-h.p. single-shaft axial turboprops and, not unnaturally, both projects caused endless trouble. Eventually, Wright threw up the sponge, abandoned their T35 unit and got in touch with Armstrong Siddeleys. Pratt and Whitney doggedly beat the T34 into a useable engine, and today, eight years from the start, it is considered ready for installation in a number of military transports.

Work on the T34 showed Pratt and Whitney that, far from being a simple box of hot air, the gas turbine was going to require more elaborate research facilities, bigger staffs of specialist engineers, more expensive tooling and a bigger expenditure of time and money than had been required by any piston engine. On the other hand, it was clear that reciprocating power-units were becoming obsolescent. It is characteristic of Pratt and Whitney that, about 1947, while Rolls-Royce, de Havilland, the General Electric Company and Allison were mass-producing simple and useable turbojets, the biggest firm of all temporarily discontinued jet design and undertook an immense programme of long-term work, little of which could bear fruit in under five years. It is safe to say that no other firm could have done the same.

The main effort went into the design and construction of the largest and finest range of engine research facilities in private hands. Largest of these establishments is the Andrew Willgoos turbine laboratory, named after the company's revered chief engineer, who died in 1949. This impressive establishment—which the editor visited, and described in our issue of January 12th, 1950—is fully equipped for the testing of all kinds of modern power units, both complete and in component form. High-altitude conditions can be reproduced on an appropriate scale.

While all this was going on, the company steadily built up a first-class team of engineers fully capable of putting these facilities to the best use. And, to keep their hand in, and also to make available fully developed engines of greater power than those then in use by the U.S. armed forces, Pratt and Whitney concluded a licensing agreement with Rolls-Royce which enabled them to manufacture the Nene and Tay turbojets. Some thousands of these engines, Americanized as the J42 and J48, are now in service with both the U.S. Navy and Air Force and, like all other Pratt and Whitney gas turbines, they are marketed under the name of Turbo-Wasp.

By the summer of 1950, the great Willgoos laboratory was at work. But the company had decided the essentials of their first turbojet long before this; in fact, components of the new engine—the J57—had already been made and were taken to the laboratory when it was completed.

Pratt and Whitney have always concentrated on engines of high power and low fuel-consumption. The fact that in filling both requirements the engine necessarily becomes relatively complex and expensive is considered a secondary matter. Accordingly, Pratt and Whitney aimed considerably further ahead than anybody else in America in the sure knowledge that the U.S. Air

TWO-SPOOL TURBO-WASP . . .

Force would be prepared to pay extra for a really efficient engine.

At the start, the J57 was visualized as a big axial to give 10,000 lb thrust. To meet the requirement of low specific fuel consumption, the newly constituted design team (headed by Wright Parkins, engineering manager, Perry Pratt, chief engineer, and W. D. Gove, senior development engineer) aimed at the unprecedented compression ratio of about 12:1. It was soon realized that such compression could not be obtained from one axial compressor drum without sacrificing much in the matter of easy starting and flexibility of operation. Just as Bristols did in this country, Pratt and Whitney decided to carry out the process of compression in two mechanically independent compressors in series.

The compressor is the most basic part of a gas turbine, and its design is usually settled first. The airflow through the J57 exceeds 200 lb/sec, and the compressor is correspondingly large; the blading in the initial rows is almost of ducted-fan calibre, as can be seen from the illustrations. The intake air enters through a large casting with six integral vanes carrying the large-diameter front bearing. After negotiating a row of guide-vanes, the air roars into the low-pressure element, which carries nine rows of blades. The compressor casing tapers rapidly and, by the time the second "spool" is reached, the diameter is down to about 27in. The second compressor has seven stages.

Most of the J57s so far built have recorded on test compression ratios around 12.5:1, which means that the air is delivered from the compressor at some 190 lb/sq in and 460 deg C. Air of this nature would make excessive demands on aluminium blading and, as in most new American engines, the J57 uses steel blading throughout the compressor. In fact, it is very hard to find any major part of the J57 which is not made of steel. This characteristic certainly makes the engines very robust and well-suited to arduous work in all temperatures, but it is also largely responsible for the fact that all J57s weigh more than 4,000 lb dry. Exhaustive studies by Pratt and Whitney showed that, were titanium alloys readily available, they could replace steel in many major components with a saving in weight of some 650 lb per engine. But not even the U.S.A.F. can afford to buy titanium alloy on this scale at present.

The high compression-ratio raises other problems. Automatic engine-controls would seem to be an essential adjunct to all J57s if operating limits are never to be exceeded. The compressor surge-lines, for example, must cross and re-cross the operating limits and, in any case, the overall range of operation must be low. Again, since the air entering the combustion chamber is already at almost 500 deg C, the burning fuel has only to add another 500 deg C to reach the turbine limit. To the quoted figure of 460 deg C should also be added a variable amount produced by kinetic ram-compression which, supersonic at sea level, can be considerable.

The split-compressor engine requires two concentric drive-shafts joining the turbine stages to their respective compressors. The tube between the high-pressure turbine and the rear compressor is quite straightforward, but the drive-shaft between the low-pressure (rear) turbine and the low-pressure (front) compressor poses some problems. Since this shaft lies inside its hollow companion, its diameter is severely restricted; accordingly, the rear turbine has to be brought up as close to its compressor as possible if a reasonable drive is to be achieved. The compressor and turbines are complete entities in themselves and, once designed, cannot readily be shortened. All the onus of keeping the J57 short therefore fell on the Pratt and Whitney Burner Development group.

The simple can-type of combustion chamber was rejected out of hand because, if excessive pressure drop is to be avoided, this system is not amenable to any reduction in length. For one thing, the central fuel nozzle makes it impossible for much primary air to get at the flame within about 5in of linear travel. The annular chamber was more attractive but, owing to the high internal pressures of the J57, all conventional annular chambers of reasonable weight would have buckled and burst within a short time. Again, no flame-tube capable of standing up to the conditions could be designed so that it could be removed from the engine without first taking the engine out of the aircraft. The J57's combustion system is unique and commendable, and it is shown in our drawing on the preceding page.

From the compressor, the air passes into a heavy machined diffuser section, where the internal pressure rises still further at the expense of velocity. The hot, dense air then enters the annular combustion zone, which houses eight flame-tubes of novel type. These cans are built-up assemblies of rings pressed from Inconel sheet—a Nimonic-like heat-resistant alloy. Part of the airflow enters the can through large holes to cool the flame, while the boundary layers flow in through peripheral slots between the rings, so cooling the metal of the can itself. This arrangement is known as the step-wall system, and the J57 can is, in spite of its homely appearance, a very highly developed unit. In the centre of each can is a unique intake for cooling air, so avoiding the formation of a hot core. Around the front of each assembly are disposed six fuel burners, making a total of 48 for the engine (this even exceeds the number used on the Sapphire). They inject a fine spray downstream, and good mixing is achieved by baffles at the upstream end which promote a local reversal of flow. With this head-start, combustion is accomplished in an impressively short distance. It may be noted that each can is virtually a complete annular combustion chamber in miniature.

The design permits very high heat-release rates with minimum pressure-drop and, owing to the similarity to the classical type of can, provides a light, small-diameter structure, with excellent resistance to buckling under high temperatures and pressures. Again, the cans can be removed with the engine installed in the aircraft.

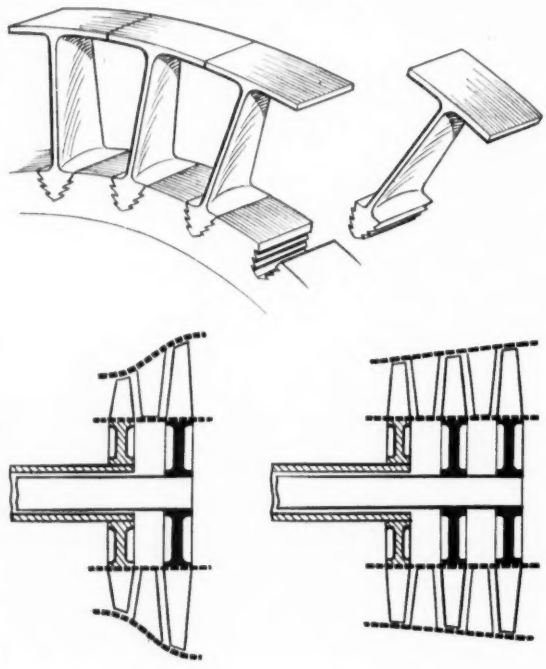
With this novel arrangement, Pratt and Whitney have achieved a combustion efficiency slightly exceeding 98 per cent at sea level, falling-off to about 96 per cent at 30,000ft, and 93 per cent at 50,000ft. The system has been subjected to exhaustive tests in the Willgoos laboratory at simulated heights up to 55,000ft and, at the latter altitude, satisfactory combustion has been achieved at all powers. In the two B-52 prototypes, a variety of J57s have been taken to high altitudes and have been put through re-lighting tests with good results. But Pratt and Whitney cannot conceal the fact that, low down at full power, the J57 smokes like a locomotive.

Attention may now be turned to the turbine assembly. Pratt and Whitney have written a comment on turbine design which is worth quoting in full:

"The magnitude of the task handed to a turbine project group is in proportion to the achievements of the compressor and burner groups. It can be assumed that if maximum fuel economy is the goal, a new high in pressure-rise ratio would be achieved by a competent organization. The burner organization would follow through with a sound design not adding girth to the engine. At this point the turbine group must pick up the ball, maintain the high efficiency of the upstream components, and not add to the diameter."

From the combustion chamber, the hot gas-flow is led through nozzle guide vanes into a high-pressure turbine. This drives the high-pressure compressor and, since it receives "full power" gas-flow direct from combustion, it can extract sufficient power in a single stage while maintaining an unchanged engine diameter. But the turbine further downstream, which is needed to drive the low-pressure compressor, can only do its job if it has a much bigger blade area, if a proper operating balance is to be maintained. To provide such blade area in a single stage would require a rotor of excessive diameter; furthermore, the abrupt

These sketches clarify points discussed in the text; above are shrouded turbine blades, while below is shown the advantage of a two-stage low-pressure turbine.



change in direction and section of the gas passage would introduce severe energy loss. By employing two low-pressure turbine stages, the requisite power can be extracted, while maintaining a reasonable diameter and a gas passage of optimum contour. This is illustrated in a drawing on the opposite page. The J57 thus has three turbine stages in all.

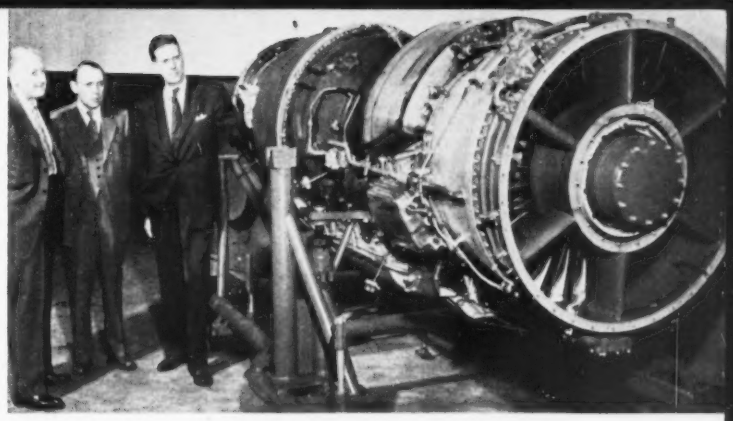
Pratt and Whitney pioneered American development of shrouded blades. The only British engines in which the use of such blading can be revealed are the Proteus and Dart. Early shrouded turbines and compressors were unsuccessful, principally owing to improper design caused by lack of knowledge. Modern shrouds are not single peripheral rings, but are formed from individual sections, integral with each blade (see drawing opposite). Not only does the shroud eliminate losses from the blade tips, but it offers considerable mechanical benefits by assisting in damping blade vibration. Pratt and Whitney, in fact, claim that the shroud weight is more than offset by the fact that thinner blade-sections can be used, which would otherwise be subject to resonance.

It is desirable to have as high an expansion ratio across the turbine as possible. The resultant large drop in pressure and temperature provides a flow much more suitable to an afterburner than a hotter, faster gas stream. In the J57, the gas leaves the last turbine stage no more than 540 dec C.

For many years, the U.S.A.F. have been quite dogmatic about afterburners; these are regarded as essential for all fighters, even those powered by the J57. Pratt and Whitney are very proud of the fact that their afterburners are entirely their own development. They have found the J57 singularly amenable to the re-heat treatment, largely on account of the high compression ratio. We have heard Pratt and Whitney engineers say that "what you can't burn in front of the turbine, you can burn behind." The large turbine-expansion ratio permits very high afterburner fuel flows, without exceeding the temperature limitations of the re-heat pipe materials. Three new Air Force fighters, the North American F-100, McDonnell F-101, and Convair F-102, are all powered with afterburning J57s (J57-P-7, -9, and -11 respectively). All these engines develop slightly more than 15,000 lb thrust, representing an augmentation of some 52 per cent over the basic rating.

Although the expansion ratio is so high, the initial compression ratio is sufficient to maintain high pressure throughout the tailpipe and afterburner. This results in excellent combustion efficiency in the afterburner at all altitudes up to the ceiling of the aircraft. In use, the afterburning is unlikely to be employed for longer than two or three minutes at a time, although we believe the U.S.A.F. acceptance test requires a 25-hour run, including periods of up to 15 minutes continuous operation. The J57 afterburner usually employs eyelids moved by a pneumatic ram fed from compressor-bleed air.

A whole range of special auxiliaries has been required for this engine, many of which fit neatly around the wasp-waisted centre section. Some shaft-driven power is taken from the high-pressure rotating assembly, but in most installations auxiliary power is provided exclusively in pneumatic form by air trapped from the last compressor-stage. Some of this air is also carried round to the front of the engine for anti-icing purposes. A noteworthy feature is the large diameter of the intake "hub"; in the B-52, this is not faired with a spinner, and the resulting flat-plate drag must be considerable. Bearing diameters are generally large in the J57, although we know Pratt and Whitney have had considerable trouble in keeping loadings at a reasonable level. The oil used is Esso Aviation Turbo Oil 15, a parallel development to the British Turbo Oil 35 by the same company, although the British lubricant is of rather higher viscosity.



Three senior executives look with pride on their company's product: Wright A. Parkins, P. and W. engineering manager; Leonard S. Hobbs, United Aircraft vice-president, engineering; and William P. Gwinn, P. and W. general manager.

So much for mechanical design. Early airborne trials were carried out with J57s slung underneath a B-50 Superfortress and a B-45 Tornado, both of which were found to fly quite happily with their four original engines stopped. In 1951, a number of J57s were put through a special-category test at 8,700 lb, to clear them for flight and, at this rating, eight were installed in the YB-52 early last year. Since then, thousands of engine hours have been achieved in numerous aircraft, mostly at a U.S.A.F. rating of about 9,500 lb. This is a conservative figure, and Pratt and Whitney expect the basic engine to be capable of eventual rating at 11,000 lb thrust.

Some hundreds of J57s have now been built as pre-production batches, and output is mounting daily. The principal source is, of course, the company's main factory at East Hartford, Connecticut, although the immense Ford plant at Chicago is now tooling-up for the J57 in place of the Wasp Major piston engine. We will also be surprised if the U.S. Navy does not establish a third source of production from one of the many companies suffering from recent Government cut-backs in other engines.

A great deal of work is going on aimed at turning the J57 into a good civil power-plant. Knowing the amount of work which this would entail, it is doubtful if the JT3L—as the civil engine will be known—can receive a Certificate of Airworthiness within at least two years. It will give 11,000 lb thrust with water-methanol and four are to power the Boeing 707 transport.

The popularity of the J57 in American fighters hinges largely upon its high compression ratio and consequent high-altitude efficiency. In such installations, it may eventually give way to the forthcoming Wright J67, which is an Americanized Bristol Olympus; with afterburner, the J67 is hoped to provide 21,000 lb thrust, while weighing no more than the J57. But the J57 is available now.

Altogether, it seems to be the J57's lot to take over where other engines fail. America is, in fact, leaning dangerously heavily on this one power-plant. W.T.G.

Pratt and Whitney J57 Turbo-Wasp

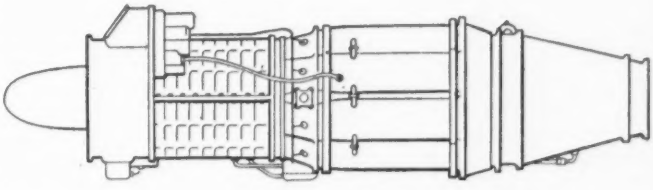
Approximate characteristics of typical basic engine, excluding afterburner: length, 155in; diameter, 39in; weight, 4,200 lb; maximum sea-level thrust, 10,000 lb at specific fuel consumption 0.78 lb/hr/lb; typical cruising thrust at sea level, 7,200 lb with s.f.c. of 0.759 lb/hr/lb. Maximum thrust with afterburner, slightly in excess of 15,000 lb. Eventual performance of basic engine, 11,000 lb thrust with s.f.c. of 0.745 lb/hr/lb.

AND NOW—A JAPANESE TURBOJET

FROM Japan comes news that the first turbojet to be designed in that country is now being assembled, and that bench tests may be expected to begin next autumn.

The engine is designated Omiya Fuji JO-1, and it is being developed by Omiya Fuji Industries, of Omiya, Saitama Prefecture, which was formerly a part of the Nakajima aircraft company. The basic design has been developed from that of the German B.M.W. 003 turbojet, a number of which were sent to Japan in a U-boat in 1944. These 003s were then used for instruction, and two (styled Ne-20) were fitted in the first Japanese jet aircraft—the Kikka, developed from the Me262 twin-engined fighter/bomber. The Kikka was to have been mass-produced for Kamikaze work with the Imperial Japanese Navy, but only one flight was made, in August 1945.

The new JO-1 is larger than the German engine. An eight-stage compressor, single-stage turbine and eight "cone-type" cans are employed. The following data are quoted (the compression ratio was originally given as "turbine compression ratio" and, in any case, is very low): Diameter, 26½in; length, 110in; dry weight, 990 lb; sea-level static thrust, 2,205 lb at 12,000 r.p.m.; specific fuel consumption, 1.11 lb/hr/lb; compression ratio, 2.3:1; air mass flow, 39¼ lb/sec.



Exterior appearance of the projected Japanese Omiya Fuji JO-1 turbojet.

POSTSCRIPT on PODS

Further Important Considerations: Jet Sound-energy Effects on Airframe Structures

FEW regular readers of this journal can remain unaware of the remarkable difference of opinion which exists between the principal aircraft engineers of this country and the United States of America concerning the preferred method of mounting turbojets in a large aircraft. Briefly, British designers favour a wing capable of enveloping the engines completely; the Americans prefer the pod—a nacelle carried on the end of a streamlined pylon.

We wrote at length about both methods in our issue of September 11th last, under the title "Pod Pros and Cons." Since the appearance of that essay a number of other points have come to light, and they deserve an airing.

A difficulty to which no reference was previously made—because little was known about it at the time—but which can now be described as understood and solved, concerns skin fatigue from jet bombardment. This is most likely to occur during take-off at full thrust. Buried engines, mounted at the root of the wing, can produce extremely high values of sound-energy intensity on the plating of the adjacent fuselage. As a general rule the noise level at a distance of one jet-nozzle diameter can be anything from 135 to 165 decibels. Such an intensity involves violently fluctuating pressure-differences sufficient to excite severe high-frequency vibration over a considerable area of fuselage skin. In one or two jet aircraft these vibrations have been found to cause large numbers of fatigue cracks over a wide area of the rear fuselage, not only in the skin but also across frames and stringers. On large aircraft the rear fuselage may be high enough from the ground to prevent detection of these cracks by eye. Successful experiments have now been undertaken with a view to developing a simple means of preventing their occurence without altering the relative positions of engines and fuselage, and without loss of thrust. Today, much is known of the effect of attaching small sections of metal in the jet-pipe nozzle to modify the flow around the periphery of the jet itself. Inserted strips, baffles, saw-tooth nozzles and other devices have all been tried and the noise-fatigue problem can be regarded as under control. A secondary, but important, advantage is that the aircraft may prove quieter both from the point of view of passengers and from that of outside observers.

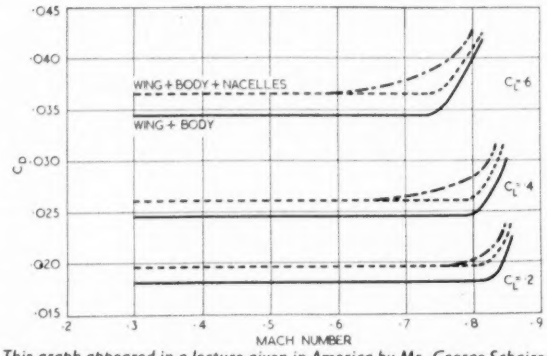
With reference to other matters raised in the article mentioned above, we have received some comments from a correspondent in America which merit quotation in full.

The B-47 Configuration

You have [writes our correspondent] brought out in your well-written article an excellent summation of "pros" for the submerged-engine case, since I think you will agree that you did not find many for pods. Actually, though, you were a little too kind to the B-47 wing configuration on the score of critical drag rise M, which you postulated at a value of 0.90—probably on the assumption, because of the obvious flexibility, that the wing is a thin one. Actually, the structural thickness/chord ratio is around 15 per cent and the aerodynamic (line-of-flight) t/c is approximately 12 per cent. Nowadays, of course, this is decidedly thick, and the fact is again confirmed by Boeing's own wind-tunnel data as openly published in Schairer's original S.A.E. paper. At high altitude (high C_L due to high wing loading), the critical M is around 0.76—say, 500 m.p.h.

Examination of Schairer's Fig. 4 (C_D vs. M at C_L from 0.2 to 0.6) indicates the second-order importance of high aspect-ratio as a contribution to low induced drag when compared with the over-riding factor of wave drag from M = 0.75 up; e.g., at a target weight of 146,000 lb (net wing-loading, 106 lb/sq ft), 40,000ft 550 m.p.h. and $C_L = 0.56$, the critical Mach number is 0.76 (approximately 500 m.p.h.). This obviously means that in the 500-550 m.p.h. range, the aircraft is ploughing up the drag rise, piling up wave drag, wasting fuel and cutting down the optimum range. Here, in fact, is the so-called "coffin corner," with the pilot juggling the throttle betwixt buffeting and high-speed stalling. A little slide-rule work suggests that the B-47 is unlikely to make a target cruise-height of 40,000 carrying its maximum bomb load of 20,000 lb and starting off with a take-off weight of 185,000 lb (wing loading, 135 lb/sq ft). With "bombs away," of course, it can get above 40,000ft.

Another rather surprising fact emerges from Boeing wind-tunnel research. From the aforesaid Fig. 4 it is quite easy to find the minimum parasite drag coefficient ($C_D = 0.0175$) and the value of the so-called aerodynamic efficiency factor "e" (or the reciprocal, the British "k" = 1/e). One gets the very low "e" value of 0.69, or k = 1.45, which means that the effective AR for the computation of induced drag is 0.69 × 8.8 (the geometric AR) = 6.1 (approx.). (Your article gives the impression of an AR of around 11.) I strongly suspect that behind the elusive "e" is the deleterious effect of the five separate bodies of fuselage plus pods—plus certain other peculiarities of spanwise load distribution caused by sweepback. It is the effective AR that really counts in overall drag; and, broadly speaking, "e" decreases with increased AR. So, even on the score of induced drag, the Boeing podded wing configuration seems illogical.



This graph appeared in a lecture given in America by Mr. George Schairer of Boeings early this year, but it was deleted from his paper presented to the R.Ae.S./I.A.S. conference. It gives drag coefficients plotted against Mach number; the chain-dotted line indicates poor pod-design and the fully dotted lower line represents a good pod.

High aspect-ratio is really a throw-back to the piston era. The three main variables for raising the critical M are, of course: (1) sweepback; (2) low aspect-ratio; and (3) wing profile-thinness. Since all three can be combined in the delta, I think your article did well to spotlight the Avro Vulcan—although, by the same token, this rather puts the Victor out of the running and makes the Valiant seem already a bit démodé, especially in view of the latter's recent "barnacle growth" for redesigned landing-gear. I was very glad to see that your article also stressed British development of modern undercarriages.

Another "contra" *re* bicycle landing gears: In a recent S.A.E. paper Convair rather let the cat out of the bag with the statement that "studies in connection with the YB-60 showed that the increased fuselage bending moment involved to install a bicycle gear amounted to an increased structural weight of 4,000 lb; i.e., about 1 per cent of the aircraft gross weight, or 22½ per cent of the total landing gear weight—a penalty that could not be tolerated." This would seem to indicate that the B-47 must be carrying around some 1,800 lb of excess metal in the fuselage. Just figure that one out on the B-52!

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Air Power at Sea

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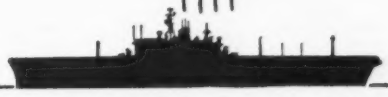

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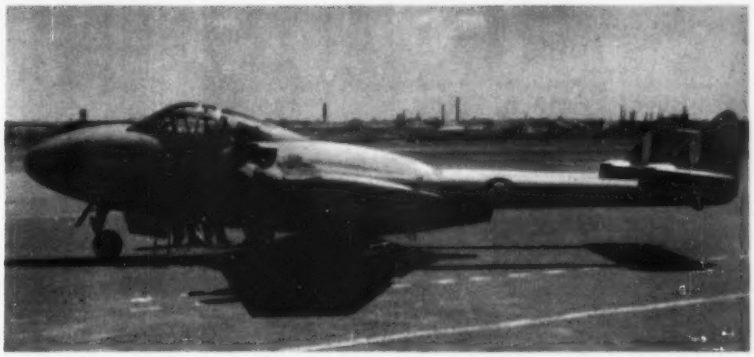
DE HAVILLAND VARIETY: De Havilland Canada, having already delivered several hundred Beavers—mostly to the U.S.A.F. and U.S. Army—are continuing production of this most successful machine. This floatplane belongs to the Sangyo Keizai Press of Osaka. It is taking off just outside that city. D.H. Australia are now delivering Vampire Trainers, one of which is seen below.

AIRCRAFT INTELLIGENCE



Great Britain

A.S.T. Target Glider. Designated C.4, the "swept delta" target developed by Air Service Training's aircraft division is capable of being towed at high Mach numbers. Equipped with a firing-error meter and a radar transponder, it is designed for towing behind any of the latest military types. A sketch on this page shows the self-trimming linkage; as speed increases, the drag of the flat plate overcomes a spring and moves the central elevator down, so making the target more nose-down in flight.

Hawker Hunter. According to our American contemporary *Aviation Week*, Hawkers have almost completed a Hunter prototype with 50 degrees sweep and a 10,000-lb thrust RA.14. But, says the American journal, "the project has been shelved by the M.o.S." Another report from America announces that the Danish government are negotiating for a number of Hunters, and the sum mentioned is $14,450,000 including spares. No doubt this order (assuming the report is correct) was confirmed after Neville Duke's little-publicized demonstration at Copenhagen (*Flight*, October 30th, p. 582).

Fighter Command. A new camouflage scheme has just been approved for day fighter aircraft based in the United Kingdom. The upper surfaces will be dark green and dark sea grey (as are all-weather fighters and aircraft of the 2nd A.T.A.F.) while the underside will be silver. It is thought unlikely that every Meteor F.8 will immediately be repainted, but the new uniform will certainly apply to Swifts and Hunters as they are issued to the Service.

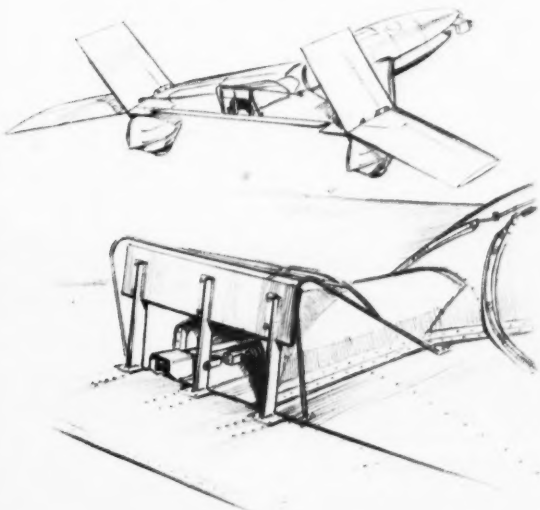
United States

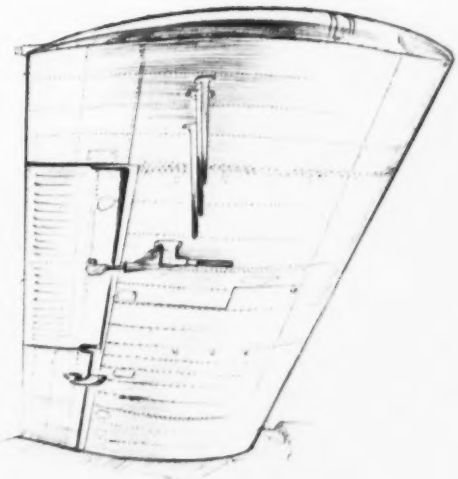
Boeing B-47 Development. During the past four years Boeing have been studying a variety of revised B-47 layouts, principally aimed at increasing range. Two projects have actually been built and, after much delay, both should fly next year. The XB-47C is powered by four big Allison J71 turbojets in single pods. (These pods are exceptionally neat and they are used in some varieties of twin-engined Douglas B-66.) The XB-47C has been virtually complete for some time but development is unlikely to proceed. The XB-47D retains the original J47 turbojets in the outboard positions but, in place of the inner paired units, single Wright T49 turboprops will be installed. These are big single-shaft engines developed from the Sapphire to give about 9,000 s.h.p. A single airscrew, with very wide blades, will be used on each T49.

France

S.E.4050 Vautour. During the official trials of the first prototype, now completed, a considerable number of pilots handled the aircraft and many senior staff officers were given a taste of transonic flight. The second machine is ready to fly; it has a new single-seat cockpit and a dorsal spine similar to that of the Mystère IV and Hunter. The radio aerial, formerly built around the canopy, Sabre fashion, has now been moved into this spine. The Sapphire-Vautour is also fast being readied, and a later prototype will be powered by two of the big French Vulcain turbojets. Standard Atar-Vautours are already going into full production for the French Air Force.

Leduc Developments. Professor René Leduc has revealed some details of his latest projects. The Leduc 021 is a subsonic test-vehicle carrying 630 gallons of fuel and, like all present Leduc ramjet aircraft, it is intended solely as a test-bed for the power plant. At low altitudes the climb will be made at Mach 0.84, with a rate of climb of 40,000ft/min. Even at 45,000ft the climb will still be some 4,000-5,000 ft/min. The Leduc 022 will, on the contrary, be fitted with swept-back wings and will be designed for a Mach number of 2. With a thrust of no less than 60 tons (probably metric units of 2,205 lb) the maximum fuel flow will be 11,000 gal/hr; all this will be handled by a pump weighing 20 lb.





TIP AND TARGET: The Percival Prince Series 5 and Pembroke operate at increased all-up weight of 13,000 lb. To meet the load, the original Prince wing has been strengthened, and an additional section has been added outboard of the ailerons (right). The camber is noteworthy. The A.S.T. C.4 target (left) is discussed on this page.

WINGS AND WAVES

—and Hardly a Wheel: a Marine-aircraft Odyssey

BY PATR

(Above) A Short Sealand of Vestlandske Luftfartselskap (West Norway Airlines) tak mountains as a background. The photograph on the left was taken from the cabin w at Kristiansund, on the route from Bergen t

THE controversy which surrounds the future use of marine aircraft seems always to take place in an atmosphere of great seriousness from which emerge ponderous quotations of costs and payloads; and many of those who cast their vote in favour of flying-boats are, one suspects, timorous of letting it be known that their decision may have been influenced simply by the fun that they have had in such aircraft.

The approach of the present writers is frankly frivolous; we enter the controversy heavily on the side of the 'boats simply because we experience the greatest pleasure in flying in them. The impressions which follow may help to explain why people get so frantic at the thought of marine aircraft being choked out of existence.

Once upon a time an aeroplane that floats was a common sight and a fairly common experience; now they seem to be found only in remote places, so that it is something of an adventure even to make the initial journey to their bases. We have had to travel to the Shetland Islands to catch a tame Sunderland, to Northern Norway to snare a Ju52/3m seaplane, and to Western Norway to find a Sealand and a Seabee, both of which had been seen at home but which were elusive when we tried to fly in them.

We'll take you to the Shetlands first.

Perhaps it was the island mists, with their attendant rainbows, which lent an air of unreality to our expedition and gave the impression that we were characters (from one of those post-war films) making a sentimental journey to the scene of past glories. The stage was aptly set. A deserted base; derelict hangars rattling in a half-gale; crumpled, rusty barbed wire; a concrete path, cracked and moss-strewn, leading to H.Q., itself bleak and abandoned; and in the distance a forsaken jetty tumbling into the water.

"Passing so close to houses that one is conscious of one's own impertinence"—a final approach to Bergen's seaplane harbour at Sandviken.

Any minute now we would hear, against the nostalgic whimper of a barrack-room ballad, the roar of an engine starting into life. The tottering buildings would pull themselves upright, the mosses would peel back, exposing neat pathways, and brisk blue-clad figures would people the now-lively landscape. But the film, it seemed, had broken down. Certainly brisk lads appeared, burly in duffle-coats, and the roar of a Twin Wasp could be heard above the howling wind; but all the inanimate objects which had toppled or sagged held fast to their decrepitude—and that was that.

Turning away from these dreary remnants we looked out towards the north-west to find a more contemporary scene. Against a back-cloth of hills—which included, ironically, the highest in Shetland—four white Coastal Command Sunderlands rode at their moorings.

We embarked in one of them and, after the usual flying-boat preliminaries, we roared down the Voe, climbed away, turned steeply over the base and flew across the green islands and golden inlets of the Shetlands. Thence we started on the long and sometimes monotonous search of the sea, which was now dark and turbulent and inhospitable to surfacing submarines.

We flew in curious suspension just below squally clouds, themselves suspended in a light sky. Rainstorms pierced the sea in isolated pools and nudged the 'boat a little roughly as it flew through them. A touch of gaiety, inappropriate to a grimly warlike operation, was added by rainbows that popped up now and then, some complete, flamboyant circles and some just shreds of coloured vapour.

We saw a varied collection of shipping taking a heavy beating in the swell. Each had to be inspected closely, identified, "attacked" if necessary or passed as friendly; then back to patrol and search until long after the light of day had disappeared westward.

The interior of the Sunderland at night has some of the qualities of a stage magician's apparatus. Standing on the solid-metal floor of the flight deck one forgets that there is more around one than this small and rather cosy windowed shell; then, startlingly, a yawning gulf opens at one's feet. Out of it a head appears, followed by a body which rises like a rather solid phantom, to disappear again behind a curtain. You turn, and from above a pair of legs swing down; again the floor dissolves, and the figure sinks. Shortly after, the smell of soup, not sulphur, rises to restore your sense of proportion.

The long patrol over, the Sunderland was turned towards base, lighthouse beams flashed out at varied intervals across the dark sea, the cliffed edges of the islands slid back under the bows, a

A AND JOHN STROUD

Best known of all flying-boats, Sunderlands had a share in this story; the photograph was taken at Garths Voe, the base from which Coastal Command aircraft were making patrols—one of which is recalled here—during Exercise Mainbrace.

T in the early-morning sunshine with Bergen's the Sealand was taxying past the salt-houses ndheim.

green flare-path rolled out from behind a black hillside, the stars swung across the cockpit windows as we made our turn into wind for the approach; then came the long, slow, downward flight towards the dark water and the alighting.

The transition from Shetland to Norway is a natural one and so we make it now in search of a Sealand.

The southernmost point of West-Norway Airlines' Sealand route is at Stavanger and it was here that we eventually embarked in the little Short flying-boat. The reflected light from the sea glittered on the cabin ceiling, the coldness of the water could be sensed through the fuselage sides and on take-off the sea rushed up above the windows for that thrilling moment before it subsided again and ultimately vanished as the aircraft rose on its step and then lifted completely into the air.

We were on our way to Bergen for a one-night stop—or so we thought—and we were to find there, although we did not know it then, a unique omen: a corrugated bathroom-geyser, very ancient, made by Junkers!

The Sealand approaches Bergen over the shoulder of a mountain. It slips down over the mountain-side, passes so close to houses that one is conscious of one's own impertinence; it slides across a harbour full of ships, flashes over high orange and yellow salt-houses. It alights in a sheltered bay almost surrounded by towering mountains.

Bergen itself is hard to leave in any case, but it is almost impossible to evade the good people of West-Norway Airlines. They threaten you with reports of bad weather in the outside world, tempt you with lobsters and mountain trout. But, worst of all, they let you play with their aeroplanes; and that does it.

On this occasion a Seabee amphibian was the plaything and from it we saw Western Norway intimately. We flew down the coast to pick up a seaman just in from the United States who, but for the Seabee, would have had no time to visit his home. Another time we skimmed across the bay, greeting a sailing boat as we passed; alighted, and taxied up to a rocky islet to disembark our passenger who lived there. We flew down the fjord to an island shipyard, tied up to a rusting hulk and smoked a cigarette among the rocks and sea-pinks while some freight was unloaded. We sped above the clear water, circled low over a farmhouse where there were friends and then flew on over fjords and islands to alight in a narrow passage of dark water. The engine of the Seabee aroused the inmates of the island hotel, a little white dog rushed down to the jetty and almost before we could disembark our order for dinner was taken. Peace was restored to the island while we ate, and then rudely shattered again as we started our take-off and flew along at the level of the hotel balconies, from which people were gaily waving. Then we climbed to decide a bet on the cloud-height and flew homewards with the sun setting benignly in this Northern sky.

Back to the Sealand again, which this time took us north to Trondheim, stopping on the way at the western towns of Ålesund, Molde and Kristiansund; towns which have had largely to be rebuilt after the wreckage of war and now, painted in delicate colours, have an unexpectedly dainty and almost Japanese appearance amid their snowy surroundings. We flew past snow-covered mountains, gleaming coppery lakes and dark sheer cliffs cleaving the sea which drew excited comments from the passengers—while in the back a famous British humorist sat dour and silent.

I suppose it must be an indication of madness cheerfully to fly over half the length of Norway, twice, to achieve a flight in a Ju52/3m floatplane. Very well, we're mad; but to step into the Junkers floatplane is also to step back into the history of aviation—and a long journey that takes you into the past and beyond the Arctic Circle is doubly satisfactory.

The short flight of steps from the float to the cabin door had long tantalized us in old photographs and when we at last surmounted it we felt we had spanned much more than the depths of Northern waters.

The Ju52 is the perfect vehicle for an Arctic journey—except, it should be whispered, in the matter of economics. Undoubtedly it rattles, but it is sturdy and rugged and it dances lightly on the water with an air of suppressed excitement which adequately reflected our own feelings. It skims effortlessly over the surface and climbs into the air like a seabird. When fog suddenly obliterates the route, or snow thickens, the Junkers can sit down on the sea or taxi on its way until it and the seagulls can resume their flights.

On our particular trips the weather was perfect. There had been a heavy fall of snow so that the islands seemed to flaunt their arcticness; but the sun shone—night and day—in a cloudless sky, the temperature was in the 80s and the sea on our alightings glittered and was warm.

The S.A.S. Ju52 route must be one of the most dramatic in the world. It passes by fantastic peaks and crevices and over dark channels which appear to cut right to the heart of Norway; the only untortured shape to be seen is the undulating corrugation of the seaplane's wing.

After the peace of floats and wings in the north how unromantic and ordinary was the return to England; and how horrible it was to arrive at a soulless and characterless land airport!

A Princess in the sky is worth . . . Saunders-Roe and a wishful P.o.W. returning by sea from Korea could give you their evaluations as we have tried to give you ours. Now it is winter and we can only sit by the fire and return in our thoughts to the days we have described—and the memories will become steadily dimmer unless something is done very soon to maintain our line of flying-boats in England.

"Whistle stops"—as made by the Seabee at this small shipyard—are characteristic of Norwegian coastal air-transport operations.

Outmoded, perhaps, but still performing faithful service—an S.A.S. Junkers Ju 52/3m floatplane at Harstad, in Arctic Norway.

One of the school's standard types is the Lockheed F-80C; here a pupil is climbing aboard for an assigned test. Like all of the school's aircraft, the Shooting Star has brightly painted wing tips and tail.

U.S.A.F. TEST-PILOT TRAINING

HIGH over the California Desert a pilot pulls back on the control column of a B-25, having put the light bomber into a steep turn. A ciné camera located behind him records the instrument readings while he brings the aircraft into an accelerated stall. This is not the first time he or other pilots have performed the manœuvre; it has been an exercise required of select groups of pilots for the past ten years. These pilots are the students attending the U.S.A.F. Experimental Flight Test Pilot School.

The school is located at the Air Force Flight Test Center, Edwards Air Force Base, Calif., one of nine research, development and testing centres of Research and Development Command. Its tuition is designed to maintain a supply of pilots capable of flight-test work at the high level of proficiency demanded by new aircraft of ever-increasing performance.

At one time, such training was an additional function of the Flight Test Center itself, and it drew its pilot-material from within Air Research and Development Command. Now the school is open to all U.S.A.F. pilots who can meet the very strict conditions for entry.

The birth of the Test Pilot School was in 1943, at Wright-Patterson Air Force Base, Ohio. At that time, only one aircraft, a North American T-6, was assigned to training duties. Later, a more formal school was established at Vandalia Municipal Airport, Dayton, Ohio. In 1945, it again moved, this time to Wright-Patterson Air Force Base. By now a full complement of aircraft was obtained, a total of twenty in all, including the T-6, F-51, B-25 and B-17. Student test-pilots were required to fly these aircraft, obtain performance data and evaluate handling qualities.

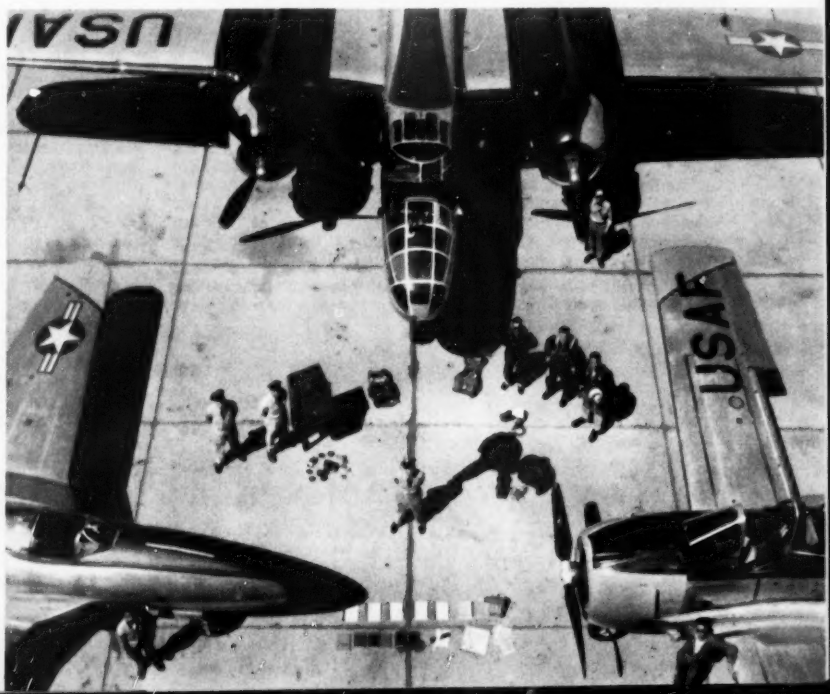
In 1946, the school was again expanded. An aircraft-stability course was added to the performance instruction; previously, the N.A.C.A. had provided the Air Force with stability data.

Operations at Wright-Patterson A.F.B. were frequently delayed by weather, which made it difficult for students to obtain the required number of flying hours in the normal duration of the course. To overcome this difficulty—and to locate the school at the place where a major portion of the Air Force's experimental test flying is accomplished—the school was moved in 1951 to the Flight Test Center.

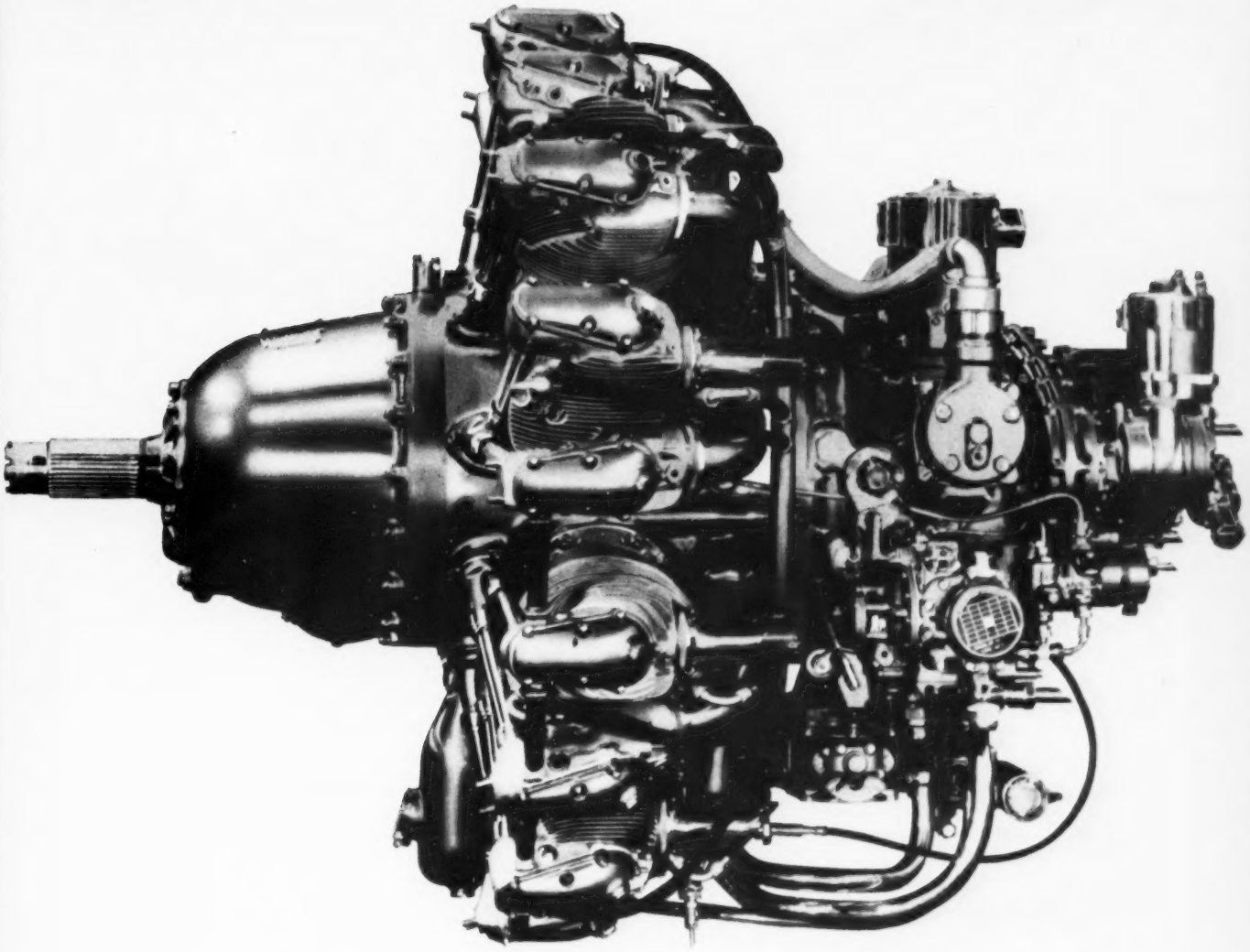
At that time, equipment was in a transition stage. In order that instruction might be obtained on jets, Lockheed F-80 Shooting Stars were added, and the T-6 was replaced by the more modern North American T-28 as a standard trainer in addition to the reliable B-25 bomber. These three types of aircraft were adopted by the school primarily because of their stability and the moderate amount of maintenance required.

Between four and five hundred pilots have attended the school since 1943. There are four courses a year, one beginning each calendar quarter and continuing for six months. Each course is strictly limited in its numbers of students, but a vacancy is held for a test-pilot from the R.C.A.F. and another from one of the aircraft companies.

Entrance requirements are strict. An applicant is normally



In the centre of this group stands Capt. Bill H. Moranville, a graduate of the Test Pilot School. Around him are the equipment and personnel that helped him through his course; they include a Lockheed F-80C, North American TB-25J and North American T-28A; two ground- and three flight-instructors; text books, cameras and film equipment, and a host of other paraphernalia.



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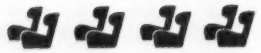

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U.S.A.F. TEST-PILOT TRAINING . . .

required to have the equivalent of two years of college in engineering, and a degree in engineering is highly desirable. He must have a minimum of 1,500 hours of diversified flying-time, and can be any rank from second lieutenant to major. If a pilot has an exceptional record, some of the normal requirements may be waived.

The syllabus includes the following subjects: algebra, trigonometry, physics, applied mechanics, properties of the atmosphere, performance aerodynamics, theoretical aerodynamics, slide-rule and calculator operations, conventional engine performance (theoretical and practical), thermodynamics, calculus, gas-turbine performance (theoretical and practical), report writing, supersonic aerodynamics, kinetic theory of gases, British flight-test methods and aircraft-stability determination methods. The classroom work is balanced by approximately 30 to 35 flight hours of performance-evaluation in the T-28 and F-80 and 35 to 40 hours of stability problems in the B-25.

During all flights, with the exception of those in the single-seat F-80, an instructor accompanies the pilot. Flight-plans may range from tests of steep take-offs and landing attitudes to long periods spent at extremely high altitudes. In addition to classroom study and flying, various extra-mural activities are included. During their six months' course, for instance, trainees visit the aircraft industries within the Los Angeles area and confer with design and production engineers; they tour N.A.C.A.'s Ames Aeronautical Laboratory at Moffett Field, near San Francisco; and they check-out from the ejection-seat training rig in the high-altitude pressure chamber at Williams Air Force Base. The two latter phases are a "must"; if a pilot fails in either of the tests he is automatically relieved from the school.

Operations at the school begin in the very early morning, in the smooth air before sunrise. Most of the morning is spent on various flight-plans, or in studying instrumentation-camera records of the previous day's flights. The afternoon schedule consists of lectures.

Upon completion of the course a number of graduates are retained at the Air Force Flight Test Center. Others are assigned to the Wright Air Development Center at Dayton, or to other bases of Air Research and Development Command, most of which require test-pilots. A few graduates are assigned to the other major Air Force Commands which may need the services of a highly trained test-pilot.

THAT NATIONAL MUSEUM

Some Suggestions for a Site

By R. G. J. NASH

IN our issue of November 6th we published an article in which A. Cdre. A. H. Wheeler, O.B.E., called attention to the urgent necessity of preserving such historic aircraft as still exist, with a view to their being housed in a national collection of wider scope than is afforded by the present Science Museum exhibits at South Kensington. In the present contribution another well-known authority on the subject, a great enthusiast for veteran vehicles, puts forward some ideas.

A SCHEME for a national museum of aircraft, such as that suggested by A. Cdre. Wheeler, has been in the back of my mind for a good many years. It was one of the reasons responsible for my gathering together interesting items of early mechanical land and air transport which might not in the ordinary way find their way to museums and which would most probably be lost or broken up.

Had sufficient finance and covered space been available over the past 25 years I could have collected over 30 various aircraft built between 1908 and 1920 and 342 automobiles built between 1893 and 1914, all being different to a larger or smaller degree. Fourteen of the 30 aircraft joined my collection and one, the Bristol Fighter, joined the Shuttleworth collection. After post-war research it was found that all the remainder were destroyed during the 1939-45 period; among them were five extremely interesting specimens that had been scheduled to join my collection in 1940; they included a Nieuport Scout and a Spad.

Before leaving the past I might mention a scheme which might, but for the war, have been a stepping-stone towards a national collection. During the period just prior to 1939 the Brooklands Motor Course authorities approached me with the idea of putting up a large building in the paddock and club-house area, the intention being to house my entire collection of over 100 specimens, including a section for racing cars which had performed on the track between 1907 and 1914 and with an overall background of the early flying days at the track.

This Brooklands scheme did in fact bring various ideas into my mind, and in the 1946-47 period I approached the Crystal Palace authorities with a suggestion that something on the lines of the Brooklands scheme be opened on part of the original exhibition site; but it was decided that the whole future of the site was at the time too fluid for anything of a concrete nature to be achieved. I also communicated with the civil aviation authorities responsible for the Heathrow Airport project, with the suggestion of incorporating a veteran aircraft museum in the plans; but I was advised that it was not possible to consider the inclusion of such a scheme in the layout as planned.

I am still of the opinion that the incorporation in some way of a national aircraft museum with London Airport would be an excellent scheme. The general public who now flock to the public enclosure are becoming more and more airminded, and the aerial traveller during pre-flight waiting would find many things of interest, easily "get-atable" and close at hand. In addition, the aeronautical student would find the earliest and latest aerial developments available for study practically under one roof.

Would it still be too late for the Ministry concerned in the new London Airport plans to consider the necessary alterations which might be made for this purpose? Perhaps a way could be found to assist the general upkeep of the exhibition by charging visitors a small inspection fee.

Should the difficulties to such a scheme prove unsurmountable perhaps the Crystal Palace site, with its excellent road and rail transport facilities, may be well worth considering, especially in view of the known drawing power of its present motor-racing. [Alexandra Palace has also been suggested to us—ED.]

I understand, also, that there are plans for the removal of Charing Cross railway terminus and, perhaps, one or more of the similarly placed stations serving the South London areas. Might it not prove possible to convert one of these for the national collection?

I am sure that the Science Museum, the Imperial War Museum, the Imperial Institute, the Royal Aeronautical Society, the Royal Aero Club and the Shuttleworth Trustees would be glad—as I would—to assist in the formation of a national collection; but with so many interests involved it would no doubt require a Government-appointed authority to consider and carry out building plans, finance and future policy considerations, and it would require action to be taken in the near future.

I personally feel that, for the present, the aircraft design-periods covered by a national collection should first represent the period from the initial development up to the conquest of large land-areas, mountains and oceans by the aeroplane—say to about 1928-1930. After this, inclusion should be extended to "landmarks" in the pre-jet period ended in 1945. Development having been rapid in the early jet age, it would only be necessary fully to cover the 1939-45 period preparatory to including landmarks up to the ending of the jet era and the initial atomic-powered period.

It would be necessary to plan (and authorize finance for) suitable buildings to cover at least the first 50 years of flight as the initial development, with sufficient land for additions.

I believe that the matter of a national collection should be considered jointly by the Ministry of Education and the civil and military air authorities, as in this way the necessary authority and finance may be found.

Perhaps, for the record, I might mention that at the present time my own collection consists of the following:—

1909-1913. Four Blériots, including Gordon Bennett Cup machine.
1912. Caudron G.3.
1913. Maurice Farman (M. Maurice Farman's personal aircraft).
1914. Avro 504 Ks, Clerget and Le Rhône.
1917. Sopwith Camel.
1918. Fokker D VII, Jadgstaffel 71 and Richthofen "Group."
1918. S.E.5a.

Incidentally, I feel that the time has come to preserve historic aircraft as "static" exhibits, and not to fly them unless duplicates are available.

I might add that over the past 25 years I have received very many letters, even from remote villages in New Zealand, conveying enthusiasm for the early development of the aeroplane, and this fact has been of great encouragement to me. The general public in this country have the same enthusiasm when they are allowed to show it, and I think this can be proved by the fact that when, in 1939, a London museum arranged for a small exhibition of four of my aircraft, plus a few engines, photographs, etc., I was informed that 46,000 persons attended in five weeks.

INSTRUMENT DESIGN

Trends and Problems as Influenced by Modern Aircraft Performance

SEVERAL aspects of an important and specialized subject are discussed in this article. Of certain of the problems mentioned by the author, it can be said that solutions have either been found or are now well within reach; improved types of altimeter, for example, are already in limited use in this country, while America's instrument industry has been responsible for some notable developments. Nevertheless, much remains to be done, and the article provides an indication of the kind of problem which instrument manufacturers are now tackling.

THE aircraft industry is continually calling for precise and readily observed indications at still higher speeds and altitudes. Established types of instruments have been modified and their range has been extended to meet these ever-increasing demands, but there must come a time when the elastic can be stretched no farther. Many flight instruments, for example, are pressure-operated; and, because with increasing altitude the density of the air becomes less, higher standards of accuracy are constantly being called for in their production. Components of many instruments currently in production have to be machined to tolerances as narrow as 0.0002in. There is a limit to the degree of accuracy obtainable even with modern methods and machines, and that limit cannot be far off.

Altimeters seem likely to continue for some time in their present form, but with an extended range. It seems impossible, however, to achieve precise accuracy at all points of a range extending from ground level to 60,000 feet and upwards without an impracticably large scale. Though instruments capable of operating with reasonable efficiency throughout such ranges have been developed, the manufacturer is presented with a number of difficult problems. For instance, when the pointer of a sensitive altimeter travels sixty times round a 3in dial, the end of the pointer covers a total distance of about forty feet, so that the magnification called for is extremely great.

Extended ranges are resulting in more cumbersome presentation and, as new instruments are developed to meet the growing requirements of subsonic and supersonic flight, the pilot's panel is becoming so crowded that it will be necessary to make increasing use of remote indicators instead of concentrating all the instruments in one small space. It seems probable that in future the tendency will be to remove the measuring mechanism from the cockpit and link it to a repeater on the dashboard.

In an aircraft travelling at high subsonic speed, the time at the pilot's disposal to observe and react to an indication is so small that before the appropriate action can be taken a considerable distance will have been covered. The pilot is much more highly stressed physically, and it is essential that all possible steps should be taken by the instrument designer to facilitate his task. Warning lamps are now frowned upon because the pilot has so many indications to observe, while at 40,000ft the "vlsibility" of his instruments is adversely affected by the general coloration outside the aircraft. Audible warnings serve useful purposes, but the number that can be installed is strictly limited.

Where no visual or audible indication can conveniently be provided, the tendency is to adopt some kind of physical warning. For example, it appears to be getting more and more difficult aerodynamically to build an inherent warning of the stall condition into an aircraft. In earlier types this condition used to be directly indicated by buffeting, but in modern aircraft it is frequently necessary to introduce some form of artificial warning. Kelvin and Hughes, Ltd., are working on one or two systems which can be used to provide an artificial warning, possibly by shaking the stick in some way.

Under present conditions it seems impossible to achieve general agreement as to the best presentation of an instrument panel, multi-turn instruments in particular presenting a special problem. For example, the standard three-pointer altimeter presentation has recently been the subject of much criticism in that the 10,000ft pointer may be temporarily obscured by the 100 and 1,000ft pointers, causing errors in readings of up to 10,000ft. One satisfactory method of overcoming this difficulty has been evolved by the firm mentioned above, who have replaced the normal 10,000ft indicator by a long pointer of distinctive shape. In emergencies the pilot can use this pointer to obtain approximate height without reference to the other two.

Doubts have been expressed as to whether the existing arrangement of instruments is the most suitable for the pilot's needs, but in the light of existing knowledge it is difficult to determine which of the variations at present being indicated are really necessary and which instruments are merely trimmings. It has been pointed out that sooner or later a halt must be called to the tendency to introduce more and more complication, and that increasing attention will have to be devoted to simplification. For instance, the air-speed indicator and the Mach meter appear at present to be overlapping in their functions to some extent. Possibly the most satisfactory procedure is to use the Mach meter for high-speed work and install a low-range air-speed indicator primarily for approaches and landings. Whether or not these two different functions can be combined in a single instrument of reasonable form remains to be seen.

As the gas turbine becomes more highly developed, engine speed is growing more and more important. The thrust from the jet is a fairly high power of the actual change in engine speed, which must therefore be very closely watched. The performance demanded of the rate-of-climb indicator is also becoming more severe, because aircraft are climbing and descending at much higher rates. [Controlled descents may call for accurate rates of up to 8,000 ft/min. Emergency rates may be much higher.—Ed.] Though it is not necessary to indicate these rates to the pilot, the instruments must be capable of withstanding that overload. Precisely what indications should be given to the pilot in this connection is part of the general presentation problem.

One important difference between the jet and piston engine from the instrument manufacturer's point of view is that the amount of vibration transmitted through the aircraft is reduced, with favourable effects on instrument life. The lack of vibration, however, is a disadvantage in other respects in that any tendency of the instrument mechanism to "stick" becomes more apparent.

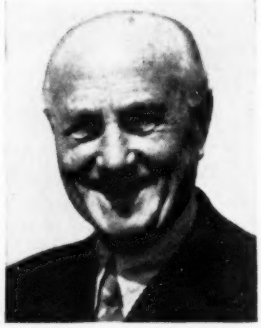
One of the biggest problems in the field of aircraft instrument design is probably the wider temperature range to be covered, which appears to be extending every year. A modern instrument must be capable of working near ground level in the Sahara Desert and also at 70,000ft a.s.l. where the temperature may reach −80 deg C. It is therefore of prime importance that careful and complete performance-tests should be made of components, materials and equipment under extreme conditions of temperature and humidity, and that susceptibility to tropical deterioration should be overcome.

The instrumentation of helicopters is a field in itself, which is full of problems still imperfectly understood. Among the principal instruments used in helicopters is the tachometer, a variation of the engine-speed indicator, whose function is to indicate the speeds of both rotor and engine. This is normally done by a dual indicator showing both speeds on the same dial. Considerable difficulties are caused by the revolution of the large rotor above the cabin, which so disturbs the airflow round the fuselage that it is impossible to measure pressure accurately for air speed or altitude in the usual way.

A.G.T.

AIR LEAGUE'S NEW PRESIDENT

THE Air League of the British Empire announces that Viscount Templewood, P.G., G.C.S.I., G.B.E., C.M.G., D.C.L., LL.D., has accepted its presidency, which has been in abeyance since Lord Harewood died in 1947. Lord Templewood—as Sir Samuel Hoare—has four times been Secretary of State for Air. He first held that office in 1922, and occupied it, except for a short interval in 1924, until 1929. In 1927 he was appointed G.B.E. in recognition of his participation, accompanied by his wife, in the inaugural Cairo-Karachi flight, in a D.H. Hercules piloted by Capt. F. L. Barnard. Lord Templewood last held office as Secretary of State for Air in 1940. He has also served as Secretary of State for India, Secretary of State for Foreign Affairs, First Lord of the Admiralty, Home Secretary, and Lord Privy Seal. From 1940 to 1944 he was Ambassador to Spain on Special Mission.



Lord Templewood.

Lord Templewood was the first honorary air commodore of any R.Aux.A.F. Squadron (No. 601); he now holds that rank in No. 604 (County of Middlesex) Squadron, and in No. 3604 (County of Middlesex) Fighter Control Unit.

POLYESTERS IN AIRCRAFT

Their Properties, and some Applications

By K. A. CLARK, B.Sc.

THE development of polyester resins in this country has aroused considerable interest in many industries, but the most outstanding advances in the handling of these materials are being shown in the aircraft and its allied industries.

They fulfil two purposes which make them useful from the point of view of the aircraft engineer and designer. Firstly, when they are laminated with fibrous glass they possess a strength/weight ratio which, besides being high, can be varied in such a way that it can be increased where still higher strength is required. When the stresses are low and this excess strength is not required a consequent saving in weight may be obtained. They are also being employed in the new techniques of casting and encapsulating electronic equipment. This technique leads to a reduction in size of the equipment, besides making it more robust and able to withstand the very wide variations in moisture and temperature conditions which Service applications demand.

Polyester resins are viscous liquids which are formed into insoluble and infusible solids by the addition of a hardening agent or catalyst. This solidification process, or "curing" as it is called, may be carried out at either room temperature or elevated temperatures and it is distinguished by the fact that it gives rise to no gaseous products. Because of this, the high pressures required during moulding operations with some other types of plastics—in order to balance the pressure of water vapour evolved—are no longer needed; so there is a saving in the size and cost of heavy plant.

Lamination and Fabrication.—Both the electrical and mechanical properties of glass-reinforced polyester resins have attracted aircraft constructors. The specific gravity is low and the tensile strength is high, being of the order of 26 tons/sq in or even higher, depending upon the type of glass selected for a particular application. The modulus of elasticity is low and this can also be altered by a suitable choice of glasscloth. Articles made from this combination show good fatigue-resistance combined with excellent resistance to damage from impact; and when such damage *does* occur they are quite easily repaired. Another point in their favour is the fact that they are completely free from corrosion hazards.

Measurements of these properties are shown in Table I, which will suggest that an impressive list could be made of the potential uses. These range from applications where lightweight, high-strength structures are required (as they are in radomes and fuel tanks) to lightly stressed, rigid structures of minimum weight, as, for example, in doors, ducting, bulkheads, containers, etc.; there are also uses where the high impact-strength is advantageous, as in protective armour and crash helmets.

TABLE I.—Properties, "Stypol" 25 glass-fabric laminate (12 plies Fibreglass 181-136)

Specific gravity	1.747
Impact strength, Izod, ft lb/in notch	15.7
Flexural strength, lb/sq in	58,000
Modulus of elasticity	3.41×10^6
Resin content, percentage by weight	43.8

Because of the exceptionally good electrical transparency of polyester-glassfibre laminates it was not unnatural that one of the first applications was in the construction of radomes. Such structures, made from this combination, provide a most satisfactory balance of mechanical and electrical properties. V.H.F. radio waves allow considerable flexibility in radome design, but in the microwave radar range the thickness of the shell becomes an important consideration, because of the fact that, like visible light passing through plate glass, this radiated power can be absorbed, refracted or reflected by the electrically-transparent glass-reinforced polyester. In addition to this the radome should be streamlined, resistant to rain erosion, and remain rigid under high airstream loads; and in very high-speed aircraft it must maintain its properties at high temperatures.

Because of the importance of the last requirement, specimens of "Stypol" 16B/Fibreglass 181-114 laminates with a resin content of 40 per cent were exposed for 30 minutes and for 200 hours and then tested at the *exposure* temperature. Table II indicates the results obtained.

When an aircraft constructor is considering the use of polyester resins in large-scale production he must decide whether or not he is obtaining a definite advantage (apart from any conferred by the general properties of the laminates) that will justify a change-over from other materials. These advantages are to be looked for in the number of components being made, tooling costs, the quality and quantity of labour needed, the ease of manufacture and the possible weight-saving.

TABLE II.—Temperature-exposure test results

Temperature (deg C)	Ultimate Strength (lb/sq in)			
	Tensile		Flexural	
	30 min	200 hr	30 min	200 hr
160	31,340	30,430	31,440	31,140
350	28,000	23,250	21,690	17,660
450	24,330	16,470	19,470	11,460
550	20,060	5,580	12,610	—

Casting and Encapsulation.—The new polyester resins are also helping to provide the answers to the many problems that confront the aircraft electrical designer. The increasing amount of electronic and control equipment that is installed in modern military aircraft has created a growing demand for miniature and lightweight assemblies. In assemblies of this type it is necessary to have close electrical spacing; and adoption of conventional methods of construction would increase the danger of failure from the effects of vibration, dust and dirt particles and condensation. Another problem found in high-altitude aircraft and guided weapons is the fact that the dielectric strength of air decreases very rapidly with increasing altitude. As a consequence, high-altitude flashover is liable to occur between the electrical wiring in such small components.

To overcome this tendency, the assemblies are constructed in a mould, the resin—which is a free-flowing liquid—being poured in so that it fills every space before it hardens. This technique not only makes the units robust but, because of the rigidity and high insulation-resistance of the resins, allows them to be miniaturized to a degree which the more conventional methods cannot attain.

In adopting the embedment technique the following properties of the polyester are kept in mind:—

Liquid Resin.	Cured Resin.
Viscosity.	Hardness, toughness.
Tank life of catalyzed material.	Thermal conductivity.
Curing procedures: must be practical for shop production and must not damage encased equipment.	Electrical insulation.
	Chemical stability.
	Machinability.

For such processes certain "Stypol" resins, manufactured by Robertson Thain, Ltd., of Ellesmere Port, were developed; these materials may be used to embed components with the aid of simple moulds and without the application of heat or pressure. When such materials and techniques are used greater numbers of electronic instruments can be incorporated into an airframe; and in the not-too-far-distant future it may be truly said that "the gadgets are no longer built around the aircraft, but the aircraft around the gadgets."

GAS-TURBINE TUITION

DETAILS of courses for the coming year have been issued by the School of Gas Turbine Technology, Farnborough Place, Hants. The subjects covered are: aero-engine design; aero engines (practical); theory and design of compressors; turbine theory and design; combustion and heat-exchangers; design and applications of industrial gas turbines; international course on aero and industrial gas turbines.

The courses are variously of one, two or three weeks' duration, and tuition fees range from 25 to 60 guineas; hostel accommodation is provided at an additional fee of 5 guineas per week.

Design courses are of approximately post-graduate standard, and are open to students of British or Commonwealth nationality. They include the running and testing of engines, together with performance calculations.

The international courses are primarily for overseas students and are a combination of the aero and industrial design courses, thus covering all applications of the gas turbine.

Open to students of any nationality, the practical courses are concerned principally with stripping, assembly and installation work, and do not require a high standard of academic knowledge.

THE AERONAUTICAL BOOKSHELF

"The Spirit of St. Louis," by Charles A. Lindbergh. John Murray, Albemarle Street, London, W.1. Illustrated. Price 21s.

THIS is Col. Lindbergh's account of his early flying days, culminating in his memorable solo non-stop New York to Paris flight in 1927. It makes a long book—over 500 pages of medium-sized type—and the author's method of presentation is ingenious. The first few chapters are devoted mainly to the planning of the flight. Then, from the moment the 220 h.p. Wright engine pulls the heavily laden little Ryan monoplane sluggishly off rain-sodden Roosevelt Field, Lindbergh gives an hour-by-hour description of the 33-hour flight; but as there was, in fact, so little to describe—just sea and sky—he fills in each hour with reminiscences of his adventures as a very young Army Air Corps pilot—flying, among other things S.E.5s—and then as a mail-flyer and (later) barnstormer on D.H.4s and Curtiss "Jennies."

These tales he tells simply and factually, without either over-accentuated highlights or false modesty; then, as each episode ends, he brings the reader back with him into the cramped cockpit as the *Spirit of St. Louis* drones eastward across the featureless ocean at an altitude of 8,000ft and an indicated air-speed of around 90 m.p.h. At each of these hour-marks he gives a detailed set of instrument readings and weather observations; and towards the end of the flight the lists grow shorter and shorter, for the pilot almost lost the battle he had been fighting against an overpowering desire for sleep.

The main story gives a reasonable proportion of technical information; and for the reader who requires more there are detailed appendices of data on both airframe and engine, including the fuel consumption and other curves on which the flight-planning was based. There can have been few, if any, more fully documented descriptions of famous flights; this one will certainly attain the status of a classic in years to come.

"The Observer's Book of Aircraft" (Second Edition), by William Green and Gerald Pollinger. Frederick Warne and Co., Ltd., Chandos House, Bedford Court, London, W.C.2. Illustrated. Price 5s.

THIS is a completely revised edition of a well-known work, and remains excellent value at the price. A photograph, silhouette and basic data are given for each of more than 100 types, and briefer information on a variety of less-important machines. The authors have brought the book as up-to-date as possible, but there are errors in the data. In some cases, such as the Douglas A3D and F4D, inaccurate dimensions are given; most Mystere IIs will have four 20mm guns, not two 30mm; the Mamba-Balliol was not the first aircraft to fly solely on turbo-prop power; the Grumman S2F requires a crew of four, not two; the Cougar has anhedral, not dihedral and carries 5in, not 0.50in, rockets; the all-up weight given for the Javelin is far from correct; and the silhouette of the Guardian shows the AF-2W, not the AF-2S. These things apart, the new edition fully maintains the standard of its predecessors.

Lunar Landscape

"Man on the Moon," Edited by Cornelius Ryan; text by Ley, Von Braun and Whipple; illustrations by Bonestell, Klep and Freeman. Sidgwick and Jackson, Ltd., 44, Museum Street, London, W.C.1. Price 25s.

MANY readers will remember an earlier work, by these and other authors, entitled *Across the Space Frontier*—a book distinguished not only by the authority of its contributors but also by the truly superb paintings of various "views" within the solar system. The new publication enjoys similarly breath-taking illustrations and is best left to introduce itself:

"In a previous work entitled *Across the Space Frontier*, the contributors to this book told the story of how man can reach beyond the atmosphere and establish a station in space within ten or fifteen years. Now, from that space station, the reader is taken another step forward—to the moon." The book is based entirely upon present knowledge of structures, rocket-chemistry, and allied subjects, and describes the entire programme of building, planning and navigating the optimum vehicles for a six-week stay on a carefully chosen part of the moon's surface. It goes further and explains what the explorers would do when they got there, and what they might themselves experience. The text is handled in such a manner that, having once begun to read, the reviewer was impelled to carry on to the end.

To anyone who wishes to be transported away from earthly cares we commend *Man on the Moon*; it is a book which we believe will grip any reader, be he scientist or layman—and leave him pondering on the subject for days afterwards.

"Instruments"—book 4 in The Aircraft Engineer's Handbook series. Sixth edition, by R. W. Sloley, M.A., B.Sc., and W. H. Coulthard, M.Sc., A.M.I.Mech.E., F.R.P.S. Published by Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, London, W.C.2. Illustrated. Price 30s.

NO introduction is necessary to the series in which this book appears. The new edition is overdue and welcome, and it is designed to cover Category X licence requirements in the repair, overhaul, testing and calibration of airborne instruments. An excellent feature is the adoption of the system, long used in Government publications, of printing a black marginal line against all new, or revised, portions of the text. These black lines are commendably numerous and the new edition is excellent in the field covered. But none of the newer (i.e., post-1950) instruments is dealt with, such as synchroscopes or Machmeters. Again, the range of patterns of instrument is rather restricted: both air- and electrically-driven horizons are dealt with, but only one model of each. No mention is made of magnetic damping. Specialist instruments, such as are associated with autopilots or the Sperry Zero Reader, are also absent, although many patterns are in airline service.

Three About Engines

"Gas Turbines and Their Problems," by Haine Constant, C.B.E., M.A., F.R.Ae.S., M.I.Mech.E., F.R.S. Todd Publishing Group, Ltd., distributed by Geo. G. Harrap and Co., Ltd., 182, High Holborn, London, W.C.1. Illustrated. Price 17s. 6d.

THIS is precisely the book that many hoped Mr. Constant would write. As director of the N.G.T.E., he has been in a uniquely favourable position from which to survey the whole gas-turbine scene. This he does in the present volume, dealing with aeronautical, industrial, marine and automotive work in a free and eminently readable manner. The book is not particularly large, yet it manages to cover an immense amount of ground. The past, present and probable future of each type of thermodynamic cycle, component, or technique is critically examined and presented in a minimum of well-chosen words.

"Aircraft Propulsion," by A. W. Morley, PhD., M.Sc., A.C.G.I., Wh.Sen.Scholar, A.F.R.Ae.S. Longmans, Green and Co., 6 and 7, Clifford Street, London, W.1. Illustrated. Price 28s.

ALTHOUGH most of our readers probably distrust any book about aero-engines which does not contain a picture of "a real" engine, there are many who are looking for a work which, although readable to the layman, covers the entire basic theory of modern power units—as opposed to a plain description of mechanical design. This is just such a work. We recommend it to all who wish to obtain a thorough basic grounding in the theory underlying all the principal forms of aircraft prime-mover.

The book offers the most lucid expositions of the various thermodynamic cycles involved and is absolutely up to date, in that reciprocating engines occupy less than 30 of the 213 pages of text. Mr. A. B. P. Beeton, of the R.A.E., has contributed two excellent chapters on ramjets and rockets, and a useful bibliography is included. The book has no obvious shortcomings.

"Power Plants for Aircraft," by Joseph Liston. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Illustrated. British price 72s. 6d.

THE author, who is professor of aeronautical engineering at Purdue University, Indiana, has produced a book which will admirably suit the purpose of anyone wishing to obtain a broad background to American piston engines. Unfortunately, such a work will find a limited public, even in America.

Out of a total text of 569 pages the only chapter devoted to gas-turbine power-units occupies but 60. Professor Liston has chosen, as a frontispiece, a photograph of an American turboprop; but the reader who seeks enlightenment in the text finds but three pages on turboprops, and these largely consist of performance curves for an early Python. The ducted fan is dealt with in even more cavalier a fashion; in the solitary paragraph accorded it the author calls it a "thrust-boosting" device and goes on to point out that "in general, fuel consumption is more than proportionately increased."

Another fundamental weakness of the work lies in its complete inability to present up-to-date information. We know how long such a publication can take to compile, but students of a rapidly changing field deserve data no more than two years old. This book is based almost entirely upon work completed and published before 1950; as a typical example, the table of American alloys used in the manufacture of turbine discs and blades is dated March 1947.

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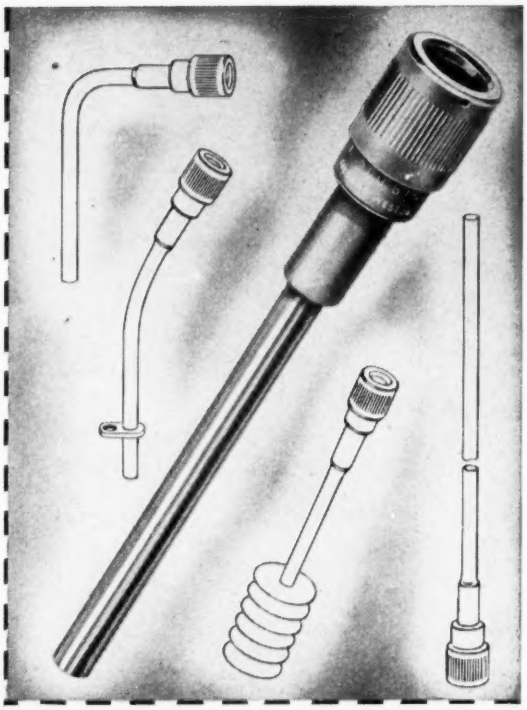
Weston Resistance Bulbs

The Model S.110 Platinum Resistance Bulb, used in conjunction with a Weston circular scale indicator is greatly superior in every respect to other methods of temperature measurement. Its platinum element is the most stable, accurate and the smallest yet produced for practical applications. Due to the very small size of the resistance element, the response time is extremely rapid. Reliability and long life are ensured by the fact that the element is hermetically sealed into a $\frac{1}{4}$" o/dia. stainless steel sheath which is fitted with a watertight plug connection. The socket is moulded integrally with special cable which is supplied. The Model S.110 is suitable for temperatures between −200°C. and +500°C. Full details of Weston equipment for aircraft will gladly be supplied on request.



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The David Brown VIG/1AR Tractor towing R.M.A. DISCOVERY, the Flagship of the B.E.A. Viscount (Discovery Class) Fleet at the 1952 S.B.A.C. Show.

By courtesy of "The Aeroplane"

A DRAWBAR PULL OF 3800 LB. enables the David Brown VIG/1AR to handle aircraft up to the Viscount, Convair, Viking, and Dakota class with ease and safety. The 4-speed gearbox with its low ratio 1st gear equips the driver for full-power 'break-out' with easy under-way gear-shift to suitable working speed. The David Brown VIG/1AR speeds up ground movement, lowers fuel costs, and although primarily designed for aircraft handling it can turn its hand to every conceivable haulage job around the airfield.

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The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Preserving Historical Aircraft

IN connection with A. Cdre. Wheeler's plea (*Flight*, November 6th) for a national air museum, it is pleasing to note that the Department of Aircraft Design at the College of Aeronautics has formed a small collection of military aircraft for instructional purposes. This group of about a dozen aeroplanes (including such notable machines as an S.R./A.1, Me163 and Lincoln) is housed in a large hangar. Accommodation of this sort, as opposed to the ridiculously cramped quarters of the Science Museum, is essential.

I would challenge the author's statement that "the aircraft industry already pays a lot for education in various technical colleges." By no stretch of the imagination can this be said. Furthermore, the zeal with which firms destroy old prototypes shows that they are far more appreciative of their financial rather than academic value.

Until the directors of Britain's aircraft firms begin to share A. Cdre. Wheeler's enthusiasm, the air museum must remain a pipe dream.

Chalfont St. Giles, Bucks. R. PRIZEMAN.

IN *Flight* of November 13th there appeared a paragraph headed "A Shock at Southampton." Having been chairman of Southampton (Eastleigh) Airport for many years, and still being chairman of the airport consultative committee, I was very concerned at the statements in the paragraph that the S.6.B seaplane was being "thrown out" and later that "it must at all costs be saved from the breakers." I take a very poor view of these statements and I refute them in every particular. The facts are:

The S.6.B has been stored in various hangars at the airport at different times. The airport commandant, W/C. S. T. Tipper—in common with, I think, everyone connected with aviation—treasures the S.6.B and has carefully guarded it on behalf of the Southampton Corporation.

The seaplane was stored in the best place possible—it was in the largest hangar, but although the seaplane has been regularly painted and preserved the hangar doors were open daily and there was always danger of a considerable amount of dust as well as damp.

W/C. Tipper was anxious to get the S.6.B under lock and key and stored under the best possible conditions. A splendid opportunity occurred for him to do this and at the same time give more hangar space; he thought of putting the seaplane in a Bessoneau hangar and locking it up, but still subject to the weekly inspection that has been carried out for years by the airport foreman, Mr. Hayward. W/C. Tipper consulted Vickers-Armstrongs, and they co-operated; the mainplanes were taken off under the supervision of their skilled staff and the S.6.B moved to where it will be secure from being tampered with and much better protected from the elements.

The S.6.B has frequently been loaned by the Southampton Corporation for various exhibitions and principally for the R.A.F. Benevolent Fund, and the mainplanes can easily be put back at any time the seaplane may be required. It will be recalled that it was loaned to the late Leslie Howard for the production of the film *The First of the Few*.

While the Southampton Airport was owned by the Southampton Corporation the intention was that the S.6.B would be on permanent exhibition in the entrance hall of the new terminal building that would have been built but for the intervention of the war. The airport has now been taken over by the Ministry of Civil Aviation and I am very confident they would defer to the wishes of the people of Southampton, and particularly to aircraft workers in the district, that the S.6.B should be in the new terminal building which will eventually be erected. The airport commandant has most carefully been looking after the S.6.B for the Southampton Corporation, and he has their complete confidence.

The S.6.B is indeed a museum-piece highly prized by the people of Southampton and Eastleigh, not only for the achievement of the seaplane itself, but as a memorial to its designer, Mr. Reg Mitchell, and all those devoted pioneers who worked with him in the production of the Supermarine seaplanes and the Vickers-Supermarine Spitfire.

Chilworth, Southampton. R. J. STRANGER.

[The statements quoted by the writer of our paragraph—a pilot calling at Eastleigh—were, as he stated, made by bystanders at the scene described. We are indeed glad to learn that the authorities concerned are, in fact, taking such care of the S.6.B, and their attitude should be an example to others with valuable historical aircraft in their keeping.—ED.]

Airline and Transport Command Pilots

WHILST not wishing to enter into an unnecessary controversy as to the relative standards of Transport Command and civil pilots—the vast majority of both are undoubtedly first class—I really cannot allow one statement of Capt. R. E. Gillman's article (September 18th) to go uncorrected.

We are surprised to learn that our days as straight navigators on long-range aircraft are at an end; and that our duties are discharged by the second or third pilot. It is unfair to the 160 specialist navigators of B.O.A.C., not to mention those of Q.E.A., S.A.A., T.W.A., N.W.A., Swissair, Air France and others, all of whom, in common no doubt with Mr. Gillman, like to think that they earn their salaries.

Admittedly, the duties of the specialist navigators have, in some cases, been modified to enable a second or third pilot to undertake the work. This has meant accepting a much lower standard of specialist plotting and log-keeping, lengthening of routes to permit beacon-to-beacon tracking (which increases operational costs) and sometimes the restriction of the pilot-navigators to certain routes and/or to daylight flying only.

No case has yet been made for the carriage of a third pilot in civil flying to undertake navigational duties. Practically always it means the replacing of the skilled experienced specialist by an officer who regards it as merely something he had to do until he can move into the right-hand seat. Long-range navigation is a full-time occupation, and a high standard cannot be maintained by part-time second pilot navigation.

In time, and with experience, a third pilot would undoubtedly approach the standard of the specialist navigator, who has ten or more years' experience of the world's routes, if he gave his full time and enthusiasm to navigation.

We cannot help but wonder if there is not an unfortunate tendency amongst some of the older executives and pilots mentally to minimize the importance of navigation today. It may be that their navigational thinking is not yet adjusted to present-day methods.

We believe specialist navigators will have an important part to play in the future of civil flying, for we cannot credit that such a wealth of knowledge and experience will be wasted.

Edgware, Middlesex. E. PALMER.

FORTHCOMING EVENTS

Nov. 28. S.L.A.E.: "Training the R.A.F. Apprentice," by G/C. R. J. Carvell.
Dec. 1. R.Ae.S. Section Lecture: "Integral Construction," by K. L. G. Legg, B.Sc., A.M.I.Mech.E., A.F.R.Ae.S.
Dec. 4. Helicopter Association: "Ground Resonance," by R. Howarth.
Dec. 4. Photogrammetric Society: "Stereoscopic Vision applied to Photogrammetry," by Professor W. D. Wright.
Dec. 9. Royal United Service Institution: "Effects on the Human Body of High-speed and High-altitude Flight," by G/C. W. K. Stewart, C.B.E., A.F.C., B.Sc., M.B., Ch.B.
Dec. 10. R.Ae.S. Main Lecture: "Training Devices for Aircrew," by N. J. G. Hill, A.M.I.A.E., A.R.Ae.S., or deputy (at Belfast).
Dec. 12. British Interplanetary Society: "Techniques of Protecting and Cooling Rocket Motor Walls," by H. Ziebland, A.M.I.Mech.E., Dpl.Ing.
Dec. 15. R.Ae.S. Section Lecture: "High-speed Wind Tunnels," by D. L. Ellis, B.Sc., A.R.T.C., F.R.Ae.S.
Dec. 15. R.Ae.C.: Film Show.
Dec. 17. R.Ae.S. Graduates' and Students' Section: Film Show (jointly with Inst. Pet.).
Dec. 17. R.Ae.C. and R.Ae.S.: Commemorative Dinner, 50th anniversary of Powered Controlled Flight.
Dec. 18-19. Institution of Production Engineers: Conference: "Problems of Aircraft Production" (at Southampton University).
Jan. 2. British Interplanetary Society: "Cosmic Radiation Hazards in Space Flight," by Dr. L. R. Shepherd, Ph.D.
Jan. 6. Institute of Metals: Informal discussion, "Lubricants for Non-ferrous Metal Working."
Jan. 7. R.Ae.S. Main Lecture: "The Fun of Finding Out in Flying," by Sir Leonard Bairstow, C.B.E., F.R.S., Hon. F.R.Ae.S.

R.Ae.S. Branch Fixtures (to Jan. 8).—Nov. 27, *Birmingham*, "Uses for the Small Gas Turbine" (speaker to be announced). Nov. 30, *Halton*, films. Dec. 2, *Luton*, "Short-haul and Charter Operations," by a charter operator; *Chester*, "Rocket Propulsion and Interplanetary Flight," by A. V. Cleaver. Dec. 4, *Bristol*, Engineering Association joint dance.

Dec. 7, *Halton and Henlow* area meeting, "Design of Fast Load-carrying Aeroplanes," by D. H. Lee, F.R.Ae.S. Dec. 8, *Bristol*, "Fly-past, Present and Future," by Capt. J. Laurence Pritchard, hon. F.R.Ae.S.; *Henlow*, "The Training of Test Pilots," by G/C. S. Wroath, A.F.C. Dec. 9, *Manchester*, "Principles of Weight Control," by F. Howarth, A.F.R.Ae.S. Dec. 11, *Preston*, Wright Brothers' Jubilee dinner dance. Dec. 17, *Bristol*, celebration of 50th anniversary of powered flight. Dec. 18, *Birmingham*, films.

Jan. 4, *Bristol*, "Review of Developments in Aircraft Equipment," by G. H. Dowty; Jan. 6, *Belfast*, joint meeting with Queen's University Film Society; *Luton*, Wilbur Wright Centenary film.

THE INDUSTRY

Prizes for Fairey Apprentices

PROOF of the soundness of Fairey Aviation's apprentice training scheme was given on November 16th, when Mr. Richard Fairey presented cash prizes to 41 apprentices from the company's Hayes group of factories, in recognition of examination successes. Last year 29 apprentices qualified for similar prizes.

Eight apprentices who had gained Higher National Certificates each received a cheque for £10. The others each received £5 to mark success in the electrical and mechanical engineering sections of the Ordinary National Certificate Examination, and in the City and Guilds intermediate machine-shop engineering and sheet-metal-work courses.

In speeches which followed the prize-giving, both Mr. Fairey and the company's production manager, Mr. A. Vines, stressed the value of shop training and the opportunities that existed on the production side of aviation in relation to those of the more popular design-offices.

"Shop experience carries particular weight if you apply eventually for a job in the D.O.," commented Mr. Vines, "and we always look for apprentices when we want to promote somebody." As an example, an ex-apprentice, Mr. J. D. K. Baillie, has this year been appointed patents engineer to the company at Hayes.

At present, there are 270 apprentices under training in the Hayes group of factories and 134 in the Stockport group. Two ex-apprentices—Mr. E. H. Smith and Mr. J. E. Wingate—have been admitted to Cranfield College of Aeronautics during the year.

The prize-winners were as follows:

Higher National Certificate, Mechanical Engineering.—G. Hemsley, D. Jackson, J. C. Stanton, P. J. Bashford, E. R. Roadknight, J. S. Dixon, R. F. Gaines, H. R. White.

Ordinary National Certificate, Mechanical Engineering.—A. J. Ham, G. R. Curtis, R. F. Esau, R. C. Van Averbeke, D. T. D. Williams, R. W. Parker, M. J. Hutton, M. W. Pennell, P. J. Wildhaber, J. Brett, R. A. Green, J. R. Harvey, J. B. Johnson, M. J. Moore, J. P. Hancock, A. P. Browne.

Ordinary National Certificate, Electrical Engineering.—J. R. Marchant, R. N. Parkhouse, B. Nolan, M. F. Rushmere.

City and Guilds Intermediate Certificate, Machine-shop Engineering.—A. F. Young, P. C. Huggett. O. Wolf, G. A. Osborne, M. A. Norman, D. R. Parker, D. R. Aird, R. J. Garnham, G. A. Wildey.

City and Guilds Intermediate Sheet-metal-work Course.—F. Park, R. C. George, W. V. Adams, S. S. Allen.

R. B. Pullin Celebrate

IN celebration of their 21st anniversary, to which reference was made on this page three weeks ago, R. B. Pullin and Co., Ltd., held a "birthday dinner" at the Clarendon Restaurant, Hammersmith, on November 4th. Mr. R. B. Pullin, O.B.E., the company's chairman, presided over a large gathering of employees and of guests from other firms and from the Ministry of Supply and other Government departments. The latter included Mr. G. W. H. Gardner, C.B.E., B.Sc., M.I.Mech.E., F.R.Ae.S., Director-General, Technical Development (Air); Mr. E. T. Jones, C.B., O.B.E., M.Eng., F.R.Ae.S., Principal Director of Scientific Research (Air); and Mr. B. D. Davies, A.M.I.Mar.E., A.F.R.Ae.S., Director of Aeronautical Equipment Production.

Not least among the enjoyable features of the evening was a series of presentations; these included gold wrist-watches, handed by Mr. Pullin to 13 of the original members of the company who are still actively connected with it. Mr. Pullin himself was a recipient of a pair of binoculars, this presentation being made by a fellow-director, Capt. A. G. Frazer-Nash, M.I.Mech.E.

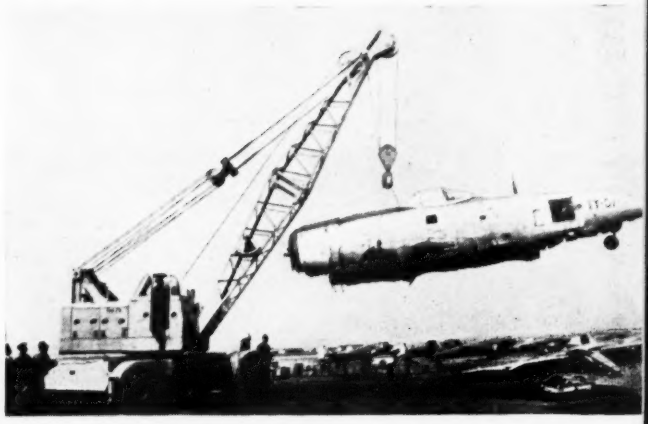
Improved Photo-electric Protection

THOUGH well known for many years in its application to burglar alarms and similar installations, the photo-electric-cell principle has hitherto suffered from limitations imposed by the distance over which the light-ray can be effectively projected. Now, however, G.E.C. have developed equipment which will permit an operating distance of 1,000yd with white light or 500yd with infra-red ("invisible") light.

Such apparatus is clearly of value for the boundary-protection of factories, airfields and other such areas, and a £30,000 order for infra-red equipment to protect the 12-mile perimeter of a secret site in the British Commonwealth is now in hand.

In the new G.E.C. system the projector transmits a light-ray which is modulated by being interrupted at high speed, so that a current signal of similar frequency is produced in the photo-cell. This signal is amplified in stages for operation on a 230-volt, single-phase, 50-cycle supply. After rectification, the signal is passed to a sensitive relay which operates immediately the light-ray is broken and initiates operation of the various alarm devices.

Being unaffected by steady light, the equipment will, it is stated, operate effectively even in bright sunlight. Furthermore, it cannot be rendered inoperative by shining a torch on to the receiver unit.



AIRLIFT: Of a type widely used for heavy airfield duties, this Coles crane, Model S.1510, is seen lifting a Thunderbolt fuselage on a Turkish Government airfield. Coles cranes are made by Steels Engineering Products, Ltd., of Sunderland.

New Cleaning Compound

STATED to be particularly effective for removing burnt-on deposits from gas-turbine components, a new liquid cleaning compound known as Hyzone 60 is announced by Hyzone Chemicals, Ltd., 662 Bath Road, Cranford, Middlesex. Among advantages claimed for the compound are that it is non-corrosive and non-staining to metals, including aluminium and magnesium alloys, and that it retains its effectiveness in store for many months.

IN BRIEF

Westland Aircraft, Ltd., in preliminary figures, announce a group profit of £74,333 (1952, £40,374), after charging U.K. taxation at £117,552 (£79,394). The annual general meeting is to be held on December 16th.

* * *

Among members elected to the council of the Society of British Paint Manufacturers, Ltd., at their recent ninth annual general meeting was Mr. W. J. Shilcock, who is joint managing director and general sales manager of Cellon, Ltd.

* * *

An article in No. 22 issue of *Wiggin Nickel Alloys* (Henry Wiggin and Co., Ltd., Birmingham, 16) describes and illustrates the precision casting of compressor blades and other gas-turbine components in Nimonic alloys by the Bristol Aeroplane Co., Ltd.

* * *

The range of marking and embossing machines and associated equipment made by Funditor, Ltd., Woodbridge Street, London, E.C.1, is described and illustrated in a new catalogue; one interesting technique described is that by which glass or metal, or other surfaces, are marked by a sand jet directed on a rubber stencil.

* * *

At an extraordinary general meeting to be held on December 3rd, shareholders of the English Electric Co., Ltd., will be asked to approve resolutions to (a) increase the authorized share capital from £10m to £15m and (b) to issue Ordinary £1 shares in capitalization of £3,538,731 of the amount now credited in the share premium account.

* * *

Mr. R. Gore, A.M.I.Mech.E., A.M.I.P.E., who has been engaged in establishing a methods development section at the new Rolls-Royce works at East Kilbride, has joined Sheepbridge Engineering, Ltd., Chesterfield, where he will be responsible for "streamlining" production methods throughout the organization. The Sheepbridge group's products, ranging from quarry machinery to I.C. engine detail components, include jet-aircraft components.

* * *

Petroleum technologists, and engine designers and others interested in the efficient use of fuels and oils, will find a great deal of profitable information in *Proving Ground*, a 58-page (8½in x 10½in) brochure published by the Esso Petroleum Co., Ltd. (Aviation Department, Artillery House, Artillery Row, London, S.W.1.) Very fully illustrated, it describes in considerable detail all the more important standard methods of laboratory-testing petroleum products.

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The woman in front of him is off to work in Victoria Street, S.W.1. An equally everyday matter to the air traveller is his trip to the other side of the world. This confidence in flying is, to a great extent, due to the reliability in service of Smiths Aircraft Instruments.

A notable addition to the long list of Smiths instruments that are supplied to all parts of the world is this Sensitive Airspeed Indicator. It has a range from 80 - 750 knots and is used extensively for flight test work and as sub-standard calibrator.

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Photograph by courtesy of Motor Panels (Coventry) Ltd.

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NAVIGATION IN SPACE

THE lecture to the British Interplanetary Society on November 7th, entitled *Navigation without Gravity*, was given by Dr. J. G. Porter instead of by Dr. R. d'E. Atkinson as originally arranged, owing to the latter's absence from the country on business. Dr. Porter is well-known for his monthly broadcasts on *The Night Sky* and, besides being the editor of the *Nautical Almanac* is an authority on comets and meteors, whose paths in many instances resemble those of future space-ships.

The lecturer said that the essence of all navigation was to get to the right place at the right time along the right route. In the old sailing-ship days there was plenty of time to get a "fix" but in modern aerial navigation an aircraft could, in the ten minutes required for the necessary calculations, travel 100 miles; the modern approach to navigation, therefore, was not to worry too much about where the craft was but to make sure that it was on the right route and that the time of arrival would be correct.

Navigation in space would be similar to old-time navigation in that the voyages would be long and that comparatively few fixes would be wanted, but would resemble modern aerial navigation in that high accuracy would be needed. A major difference between terrestrial and space navigation was that on Earth one dimension was virtually fixed and only latitude and longitude were needed, whereas in space the navigation would be three-dimensional. The measurements needed for a fix could be distances, velocities or angles.

It had been proposed on a number of occasions to send off an unmanned, unnavigated space-vessel, relying simply on the accuracy of its take-off speed, angle and time to bring it to the prescribed point at the right time. This could be quite easily shown to be a highly improbable proposition. Taking a Mars journey as an example, with a trip time of 281 days (this was not the orbit for minimum energy-consumption) the starting speed from the Earth's orbit (round the sun) would be 20.68 miles per second, and the speed on arrival in the Mars orbit would be 12.41 miles/sec. Since the mean orbital velocity of Mars was 13.64 miles/sec the vessel could not afford to be late; but it could be slightly early, so that Mars caught it up before it moved too far out of the planet's orbit. An error of about 50,000 miles could be tolerated and Mars would then catch-up the vessel in 11 hours. An error in take-off velocity of 1 per cent would produce a 5 per cent positional error at the end of the orbit; thus an error of 1 per cent would give a 7 x 10^6 miles error in the Mars orbit. To obtain the necessary accuracy the allowable error in the take-off velocity would be only 0.001 miles/sec, or about 3½ m.p.h.! The angle of take-off with reference to the Earth's orbit must also be within one minute of arc. Both of these conditions were likely to be very difficult to achieve in practice, and so a system of navigation would almost certainly be required.

Since the motion of the space-ship would be in a plane containing the Sun the calculations would be greatly simplified and, in fact, the complete calculation of the orbit considered above, taking into account the perturbing effect of all the major bodies in the solar system, would take only 30 hours by hand or about five minutes using an electronic computer like Edsac. Dr. Porter did not think that the future of space navigation would depend on the present method involving angular measurements. The most convenient bodies to use for this method would be the planets, but appreciable errors would be involved; for example, Jupiter's diameter was 80,000 miles and an error of half this amount could easily occur if it were incorrectly sighted.

The velocity of the vehicle could be measured by a radar Döppler method, and this value used, but the lecturer thought that a promising method of navigation might be that of photographing the Sun at regular intervals. The apparent diameter would give an indication of the distance from the Sun. Alternatively, the amount of heat or light could be measured and used instead—although, if the Sun turned out to be a variable star, this might upset calculations. (In the discussion, the chairman of the B.I.S. also pointed out that the presence of very large sunspots might also cause confusion). If the missile's attitude could be stabilized very accurately at take-off, then any deviation of the series of photographs from a straight line would be a measure of the deviation from the plane of the true estimated orbit.

Once an error in course had been detected the problem of correction would arise, and this would be by no means easy. Because of gyroscopic effects, a force applied in one direction produced effects along axes at right angles to it; and if, for example, the rocket jets were turned on to increase the speed, the size of the orbit itself would also be increased. The effect of a given force could therefore be complex, and there were certain parts of the vessel's orbit where corrections could be most easily made.

In the discussion various methods of determining the position of a space-ship were suggested, including that of firing off one or more radio beacons into space, so that they would enter various orbits which could be very accurately determined; these beacons could then be used to obtain very accurate navigational data. The use of radio beacons at different points on Earth, or even on the Earth and on the Moon, was not considered practicable for a Mars journey since the base-line obtainable would not be long enough to give the required accuracy.

Equipment-Cooling in Supersonic Flight

THIS article is an abridged version of a paper, "Cooling Electric Equipment during Supersonic Flight," presented by Mr. Doyle C. Wells (electronic engineer, Ryan Aeronautical Company) at the National Aeronautic Meeting of the Society of Automotive Engineers, which took place recently in Los Angeles.

THE cooling environment imposed on a piece of equipment by an aircraft up to a few years ago was not far different from that of a ground- or sea-based vehicle. Today, in contrast, the environment has changed drastically with higher speeds and altitudes.

Cooling in the past has been done by passing air over and through the equipment. This air was taken from outside the aircraft, through ram-air intakes. It can be shown, however, that the temperature of ram air will rise excessively at approximately Mach 1. Thus, at supersonic speeds any air taken from outside will be too hot to use at its existing temperature, and air inside will also be too hot to use after steady-state conditions are reached.

On present-day aircraft, the situation is handled in two ways. Either air-cycle refrigeration is used to reduce the air temperature, or the equipment itself is built to withstand the increased temperatures. The real solution to the problem for electronic equipment, however, is a cooling system that is independent of aircraft speed and altitude. This means that atmospheric air cannot be used as a direct heat transfer medium or heat sink.

The use of the aircraft's fuel as a coolant has many possibilities. The effectiveness of jet fuel in a heat exchanger can be shown to be approximately half that of water and, assuming a flow rate of some 30 gal/minute, 2.5 kW of energy could be absorbed by the fuel for each degree Centigrade rise in fuel temperature.

The boiling of a liquid in a heat-exchanger, or in passages in the equipment, has moderate possibilities as a heat-sink. Although there are many possible liquids, none compares with water in terms of latent heat, density and availability.

The sublimation of a solid in the presence of a liquid coolant does not offer as much on a weight-for-weight basis as either of the above two systems.

In the past year, some work on liquid cooling systems and associated components has been undertaken by the Ryan Aeronautical Company, in connection with "sub-miniaturized" electronic equipment, microwave power tubes and electric motors and generators. In general, sub-miniaturized equipment with power densities as high as 2 watts/cu in can be cooled with liquid. Small liquid-cooled A.C. motors can be run continuously at more than twice their normal (air-cooled) power. A microwave transmitter tube with a dissipation of over 50 watts/sq in has been cooled with a liquid system in which the liquid velocity was purposely kept low to avoid tube noise. A small centrifugal pump driven by a three-phase 400-cycle motor drawing 30 VA was used to circulate the coolant.

The liquid used in most cases was triethylene glycol and was chosen for its specific heat, high density, low freezing point and low vapour pressure which permits operation at 50,000ft without pressurization. This liquid has a high viscosity at low temperatures, necessitating a careful consideration of all aspects of pump design. In general, pump clearances are made large, fewer guidance vanes are necessary and high velocities are avoided. As a general rule, pumps with 40 to 50 per cent efficiency are possible with this viscous liquid. It takes approximately five watts of electrical energy at the pump input for every 100 watts of heat to be removed by the cooling system, although this figure may vary twofold, depending on the specific requirement of a system.

In the future, when aircraft speeds progress well past transonic velocities, and when altitudes of 15 miles are commonplace, not only electronic equipment, but hydraulic and rotating electrical machinery will also have to be cooled by means other than air. It would appear that fuel would be the best choice for an integrated aircraft cooling system heat sink, although liquid evaporation will find its place for small isolated pieces of equipment.

CIVIL AVIATION

B.I.A.T.A.'s ANNUAL REVIEW

THE annual dinner of the British Independent Air Transport Association, held at the Mayfair Hotel, London, on November 19th, was a most successful and enjoyable occasion, some 150 guests being present.

The chairman of the Association, A. Cdre. Griffith Powell, C.B.E., proposed "The Guests." He said that the Association was fairly well satisfied with the year's progress in the operating sense. "A little bread is better than no bread at all, but it is a dull commodity as a steady diet." The setting-up of Air Finance, Ltd., was welcome. The Association would welcome the Armed Forces setting up a reserve of aircraft to be let out for operation to the independents and other aircraft operators.

[In connection with trooping requirements and the need to maintain an air transport reserve in the absence of a strong Transport Command of the R.A.F., a good case can be made financially for the purchase by the Services of transport aircraft to their own choice. Such machines could be operated in peacetime by one or more of the independent companies, for example, who would look after the trooping commitments at an economical rate and at other times would operate the machines commercially, so making full and economical use of them.—Ed.]

A. Cdre. Powell paid a tribute to Lord Terrington and to Viscount Runciman for the work of the Air Transport Advisory Council. Of the Anglo-Irish agreement now under review it was made clear that from the independents' point of view there had in the past been much that was regarded as unsatisfactory. The independents hoped for improvements. A. Cdre. Powell said that B.I.A.T.A. had assumed a very strong position in the European deliberations of F.I.T.A.P., and had come to the fore in world independent air-transport deliberations. During his speech the chairman also regretted that Mr. David McIntyre, the vice-chairman, would not be able to take over the chair in the following year, but he welcomed the new vice-chairman, Mr. Maurice Curtis, and the new treasurer, Mr. G. H. Freeman, who was to succeed Mr. Bamberg at the end of the year.

Concluding his speech, he referred to new friendships formed consequent upon the joining-up of the M.C.A. and Transport Ministries, and he welcomed former Ministers in Lord Winster and Mr. Maclay.

Viscount Runciman, deputy chairman of the Air Transport Advisory Council, replied for the guests. He mentioned that since June last, 237 applications had been submitted to the Council, of which 214 had come from independents. Fourteen had been withdrawn while under consideration, 10 more had been withdrawn after approval, 171 had been finally recommended, and of these 107 had so far been approved.

The third speaker was the Parliamentary Under-Secretary for War, Colonel J. R. H. Hutchison. He said that the War Office was the independents' best customer and he commended the independents upon bringing a flexible mind to joint problems and dealing with them in a reasonable manner. The original trooping plan had provided for 25,000 per annum, whereas the present rate was 72,000 per annum and in the last year there had been in addition the air movement of two brigades to Kenya. Trooping represented 24 per cent of the total passengers carried by the independents, or on a mileage basis, 72 per cent of the work. The War Office had some contracts and commitments with the shipping companies but were anxious to continue air trooping, and to see that transport companies had safe and adequate aircraft. Colonel Hutchison said that he had chosen for his toast the prosperity and future of British air transport.

The final speaker was the vice chairman of the Association, Mr. D. F. McIntyre, A.F.C., who employed an amusing analogy of the fortunes of three, and later only two, fat and favoured pups by comparison with the lean ones in obtaining a share of the single dish of food. Thanks to the Army and Air Ministry another dish of food had been put down for the little and thin pups.

The B.I.A.T.A. dinner is an occasion of considerable significance to the independent airlines, and it was unfortunate that, as Mr. Lennox-Boyd (who has been out of the country) was unable to attend for the second year running, his Parliamentary Secretary, Mr. Profumo, should also be absent.

There follow some highlights from the B.I.A.T.A. annual report, which covers the period July 1st, 1952, to June 30th, 1953:

Scheduled Services.—Available capacity ton-miles flown by British independent operators increased by 78.7 per cent—from 4,035,000 to 7,214,000. Load ton-miles performed increased 92 per cent—from 2,356,000 to 4,526,000—and the overall load factor went up from 58.4 per cent to 62.7 per cent. The number of passengers carried was over 149,000—more than twice as many as in 1951-1952—and the fact that traffic increases were mainly on the international routes is reflected in the 135.7 per cent increase in passenger-miles flown—from nearly 15m to 35m. By operating 98.7 per cent of the 30,699 flights scheduled for the period, the independents achieved slightly higher regularity than either B.O.A.C. or B.E.A.

Non-scheduled Operations.—Capacity and load ton-miles flown during the year were approximately eight times as great as those performed on scheduled services. Apart from normal charter operations, B.I.A.T.A. members flew nearly 50,000 refugees from Berlin to Western Germany, as well as 34,000 tons of freight. Trooping operations accounted for 50 per cent of the total passengers carried on non-scheduled flights by B.I.A.T.A. members, and for 84 per cent of the total passenger mileage. The report quotes some official comparative costs of sea and air trooping and notes the Select Committee on Estimates view that even if the cost of trooping by air were higher than trooping by sea, this would be outweighed by the saving in time and therefore of man-hours — an elimination of wastage particularly important in the case of National Servicemen.

The figures show that charter aircraft can take a man from the United Kingdom to Egypt for £22, compared with an average troopship fare of £30; the corresponding cost by commercial ship would be £40 and by B.O.A.C. £86. Figures for the U.K.-Singapore route are: charter aircraft, £100; troopship, £75; commercial, £135; and B.O.A.C., £206. Capacity ton-miles offered by B.I.A.T.A. aircraft on non-scheduled flights during the year totalled a record 57,994,000—an increase of 119 per cent. Load ton-miles performed increased by 116 per cent to 38,239,000. Even greater was the increase of 133 per cent in the number of passengers carried (175,584).

Combined Operations.—On both regular and non-scheduled services B.I.A.T.A. members performed 42,765,000 load ton-miles, corresponding figures for B.E.A. and B.O.A.C. during the same period being 46,500,000 and 140,094,000.

Fleet Strength.—At June 30th B.I.A.T.A. members were operating 40 four-engined aircraft, 113 twin-engined aircraft and 8 single-engined aircraft. The all-up-weight of this fleet, by comparison with the previous year, had increased by 62 per cent to 5,012,000 lb.

In conclusion the report urges that the independents should not be considered as the "poor relations" of the State Corporations. In this respect, it adds, the present policy of blending private and public enterprise is emerging along the right lines "so long as the policy is given full and active backing."

RAPIDE 4 TO NAIROBI

NEWS has come from Mr. Alec Noon of his flight from Southampton to Nairobi in VP-KLL, the Rapide 4 whose performance was described by the Editor in last week's issue. Starting on November 4th, the aircraft was delayed by fog at Toussous le Noble, and later by severe thunderstorms and more fog in Southern France and Sardinia. The machine behaved extremely well on the flight, Mr. Noon reports, and was to have been demonstrated before representatives of East African Airways Corporation and other local companies during this week. The operating company, Noon and Pearce Air Charters, Ltd., are based at Nairobi West Airport.

PIG-LIFT TO JUGOSLAVIA

APPROXIMATELY one thousand pedigree pigs (total value some £50,000) are being flown from England to Jugoslavia by Eagle Aviation and Sabena. Following six trial flights in June of this year, on which a total of 120 pigs were carried by Eagle, the first flight of the major contract was made on November 20th by the same company. Two specially equipped Dakotas are being used, and the route is Blackbushe-Munich-Belgrade (Zemun).

Sabena, also, is using Dakotas and flying from Blackbushe to carry out their pig-lift contract. The first such flight by the Belgian airline was scheduled for midnight on Monday last, and two flights were subsequently to be made each night for a fortnight.

The aim of the large-scale operations is to improve Jugoslav bacon production; the animals have been selected from over 100 English farms, and moved to a special "transit farm" near Blackbushe, where personal details such as weight are listed and health documents checked prior to the flights.

NEW SERVICES APPROVED

CONDITIONAL approval of three new seasonal services by British independent operators is announced by the Ministry of Transport and Civil Aviation. Air Kruise (Kent), Ltd., have permission to operate an internal service between Ramsgate and/or Lympne and Birmingham from April to September each year until September 1960. A second scheduled service is to be operated by Aquila Airways between Southampton Water and Capri with an optional traffic stop at Marseilles also from April

to September each year until September 1960. The third approval covers an inclusive tour by Transair, Ltd., between Gatwick and Alghero, Sardinia, with technical stops at Lyon or Marseilles, to be operated between June and September until September 1955.

Aquila Airways have announced that a proving flight to Capri will be made next April and that scheduled services are expected to begin the following month. The route will be flown in about six hours by Hythes and Solents. Only first-class passages will be offered, the return fare being £65 5s.

I.A.T.A. DISCUSS CARGO-RATES

THE major subject on the agenda of the latest I.A.T.A. Traffic Conference, held last week at Honolulu, was the question of standard cargo-rates to be charged on the North Atlantic route by the eleven regular airlines concerned. Although all these operators agreed on the need for attracting extra traffic they had proposed widely differing methods of doing it.

Two companies, P.A.W.A. and K.L.M., are now operating all-freight DC-6As and were understandably anxious to bring in rates more closely related to the lower operating cost of these aircraft. Over a month before the conference Pan American filed with the C.A.B. a new transatlantic rate-structure offering reductions of as much as 45 per cent for consignments of 1,100 lb and over, compared with the maximum permitted discount of 25 per cent for shipments of over 100 lb. Pan American also proposed to do away with the complex system now in force of different rates for specific commodities. The rate suggested by Pan American, however, was unacceptable to practically all the airlines represented at Honolulu and it was finally agreed to extend the existing pattern of rates until March 31st, 1955.

Under this revised agreement the basic rate for general merchandise will remain unchanged at 7s 10d per lb between New York and London with a 25 per cent discount for shipments weighing over 100 lb. The chief concession to those carriers urging reductions in rates will be the introduction of a second "break point," after April 1st next year, permitting reductions of 30 per cent on shipments weighing over 440 lb.

Both P.A.W.A. and K.L.M. have withdrawn their applications to the C.A.B. for lower rates. Changes in commodity rates will be made by unanimous vote of an official body representing all the interested airlines. This body, the I.A.T.A. Specific Commodity Rates Board, formerly comprising five representatives chosen in rotation, will in future include delegates of Air France, B.O.A.C., El Al, K.L.M., L.A.I., P.A.W.A., Sabena, S.A.S., Swissair, T.C.A. and T.W.A. I.A.T.A. states that the board has been directed to "take a liberal and constructive approach towards the establishment of new commodity rates at the most attractive levels consistent with the economy of the industry."

Chairman of the conference was Mr. R. W. Ireland, vice-president of United Air Lines. He announced last week that I.A.T.A. had also approved a new set of cargo regulations providing for carriage of special medical goods throughout the world on an interline basis. Previously, such items as radio-active isotopes—which have very short effective lives and in many instances can be transported only by air—could not be carried on main routes served only by two or more airlines.

The new code, evolved by a working group, which has taken nearly three years to complete, covers the classification, certification, labelling and packaging of several thousand commodities which require special stowage and handling. Standard labels have been designed to ensure that cargo handlers appreciate the properties of delicate or dangerous materials.

EXAMPLES of the new I.A.T.A. labels which, as reported above, are part of a code governing acceptance and carriage of special cargoes. The central design is for Group III radio-active materials; the symbol on the left denotes corrosive and caustic liquids; on the right is the label for a package containing poison, poison gas and tear gas.

VETERANS: Among the captains flying for Australian National Airways are two of the world's most experienced airline pilots. On the left, receiving a presentation wrist-watch from Capt. I. N. Holyman, managing director, is Capt. Jason Hazzard (20,550 hr); he was taught to fly in 1930 by his uncle, Capt. K. Virtue (centre), who has flown 22,170 hr.

DC-7s FOR E.A.L.

IT was announced last week that Eastern Air Lines have placed a $25m (£8·9m) order for 12 Douglas DC-7s, for delivery early in 1955. The order brings the number of DC-7s now sold to 81. Eastern's fleet, one of the largest in the world, consists of 11 DC-4s, 57 Martin 4-0-4s, 20 Constellations and 14 Super Constellations; the airline has also placed additional orders for 22 compound-engined Super Constellations.

STRATOCRUISER SERVICE FOR RINGWAY

PERMISSION is being sought by B.O.A.C. for a weekly Stratocruiser service connecting Manchester and New York. It is proposed that the aircraft, carrying first-class passengers only, will operate from London, making calls *en route* to New York at Manchester, Prestwick and Gander. Although the possibilities of such a service have been under discussion between B.O.A.C. and the Manchester civil authorities for some time, Sabena were first off the mark in providing this important city with a direct air service to America. The Belgian airline's DC-6B tourist service from Ringway to Idlewild was inaugurated on October 29th, and it is difficult to escape the conclusion that this enterprising move acted as a spur to B.O.A.C.

PISTONS PREFERRED

AS reported recently in *Flight*, Australian National Airways have ordered two Douglas DC-6s and two DC-6Bs to supplement their present fleet of 8 DC-4s, 20 DC-3s and 3 Bristol 170s. It will be remembered that in December last year A.N.A. cancelled a provisional order for Viscounts. Our Australian contemporary *Aircraft* reports that A.N.A's managing director, Capt. I. N. Holyman, has been freely criticized for this decision and quotes the following explanation for his choice of American aircraft: "I do not, in any way, discount the Viscount, which is a very good machine. I am of the opinion, however, that the public will like these DC-6s better, and that their economics, utility and versatility will make them a better buy, viewed in relation to our continuing policy of developing both passenger and freight traffic side by side."

The two DC-6s due for introduction on A.N.A.'s routes next month have been bought from National Air Lines; the DC-6Bs, which will not arrive until early 1955, are being ordered direct from the manufacturers. Both types are being equipped as 58-seaters. The first of six Viscounts ordered by the State-owned company, T.A.A., is due for delivery next June.

SILVER CITY PLANS

AN additional order for three Bristol 170 Mk 32s—Superfreighters—was announced last week by A. Cdre. G. J. Powell, managing director of Silver City Airways. The order, valued at £300,000, follows up the airline's purchase and introduction into service during the summer of six Mk 32s. Stating that he expected the additional Superfreighters to be delivered next spring, A. Cdre. Powell added that he was planning to buy three more for 1955. The new Bristols will be required to deal with the increased traffic forecast by the past season's outstanding results; the 1953 total of vehicles carried across the channel has already reached

CIVIL AVIATION . . .

38,000 compared with 11,000 over the whole of last year.

A. Cdre. Powell confirmed that Silver City had started to build their airfield, Ferryfield, on the tip of Dungeness. It was expected that from next June onwards the Le Touquet service would be flown from Ferryfield and that aircraft from Lympne would operate the new ferry service to Calais.

BREVITIES

THE President of K.L.M., Dr. Albert Plesman, forecast recently that his company would have both pure jet and turboprop airliners within five years. No specific types were mentioned.

* * *

According to a statement issued by the Canadian Pacific Airlines, the cost of the three Comet 2s recently ordered by the company will be about £1,600,000. The option on a fourth Comet 2, if taken up, would involve an outlay of a further £360,000.

* * *

The Lockheed Aircraft Corporation reports that Luftag, forerunner of the revived Lufthansa, has signed a formal contract for the purchase of four Super Constellations. Orders for all other versions of the type now cover a total of just over 500, of which 132 are Super Constellations.

* * *

On test at London Airport by B.O.A.C., and later to be tried at airfields abroad, is a prototype 12-seater "crew car"—in effect, a miniature motor-coach. Incorporating Ford units, it is built by Thomas Harrington, Ltd., of Hove.

Braathens S.A.F.E., the Norwegian independent company, have been refused permanent approval by the Norwegian Government for their Far East service, which has for over a year been operated on a temporary permit. A Norwegian Cabinet meeting, presided over by King Haakon, decided that the country's interests in the Far East routes would be more efficiently met through the inter-Scandinavian national airline, S.A.S.

* * *

The second regional air navigational meeting held to discuss technical plans for the African and Indian Ocean region of I.C.A.O. opened at Teneriffe on November 17th. The United Kingdom delegation, led by G. J. Warcup of the M.T.C.A., includes representatives of the Rhodesias and of the British Colonies in the region.

* * *

The Bendix Aviation Corporation has received an Indian Government contract for surveillance and precision approach (G.C.A.) radar to be installed at Santa Cruz Airport, Bombay. Similar equipment will be installed at other Indian airports if the Santa Cruz radar proves sufficiently useful. This initial contract is valued at between $500,000 and $1m.

* * *

Super Constellations were recently introduced on the North Atlantic services of Air France. In addition to the first-class flights to New York, Montreal and Chicago and Mexico, the new aircraft are being used on an ultra-luxury service, the Parisian Special, which flies weekly between Paris and New York. Passengers using this service pay a supplement of £8 19s per single journey for the privilege; a further charge of £22 6s gives access to a self-contained "skyroom," a compartment which can be used as a private drawing room by day and a two-berth cabin at night.

CLUB AND GLIDING NEWS

DENHAM Flying Club invite the penetration of their defences in a lunch patrol this Sunday, November 29th, between noon and 12.30 p.m. The defended zone is from one to two miles from the airfield perimeter, between 1,200 and 3,200ft above sea level (Denham altitude, 250ft). During the afternoon a landing competition will be held, followed by what is termed an "obstacle race." As Denham is located within the London control zone, would-be attackers are requested to telephone the club (Denham 2161) to confirm V.F.R. conditions before take-off.

FEW changes were made in the composition of the Vintage Aeroplane Club's committee at the annual general meeting elections on November 7th. Ron Gillman and David Ogilvy remain as chairman and secretary respectively, while Major W. L. Foster (treasurer) and Dennis Bootle join the committee. Re-elections to the committee were those of Beverley Snook, Denys Stonebanks and R. P. Green (who has been in charge of the recently completed C. of A. overhaul on the Avro Cadet).

AT Elstree, a works flying club has been formed by Handley Page, Ltd., and should begin operations soon. Flying hours for the Elstree Club during October amounted to 225½, with six non-flying days, and several others on which activities were severely restricted by the weather.

DURING October, the Strathtay Aero Club began to provide flying for A.T.C. cadets under the "air experience" scheme, using an Autocrat. Three A.T.C. Flying Scholarship cadets and Mr. W. Warden, from South Africa, qualified for their Private Pilots' Licences, and flying time for the month was 78½ hours.

THE first anniversary of the Coventry Gliding Club was recently celebrated. Operating from Baginton, the club's 50 flying members made a total of over 2,100 launches during this first year, and obtained 12 "A" Certificates, 12 "B"s and four "C"s. The club owns a T.21B two-seater, and has the use of a Grunau Baby and a Kirby Cadet belonging to the Leicester Gliding Club, whose members also fly from Baginton at present.

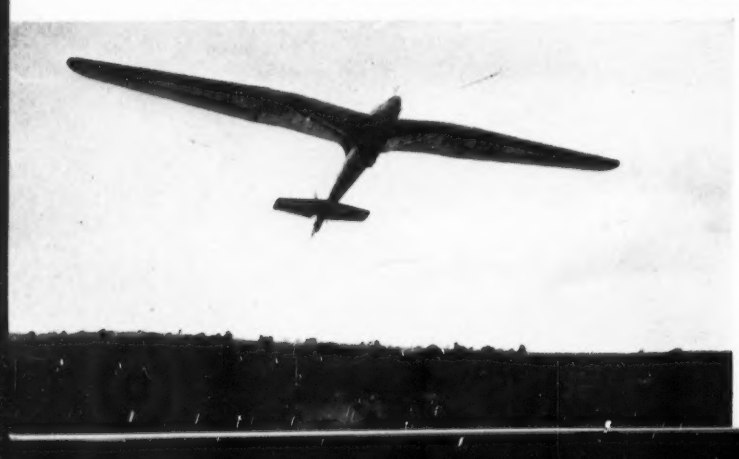
Mr. George Thompson, previously with the Derby and Lancs Club, is now C.F.I. at Coventry. The club hopes to obtain its own winch (at present that of the Leicester club and auto-tows are used) and a high-performance sailplane in the coming year.

The Lustraphone microphone, boom-fitted to an H.S.33 headset.

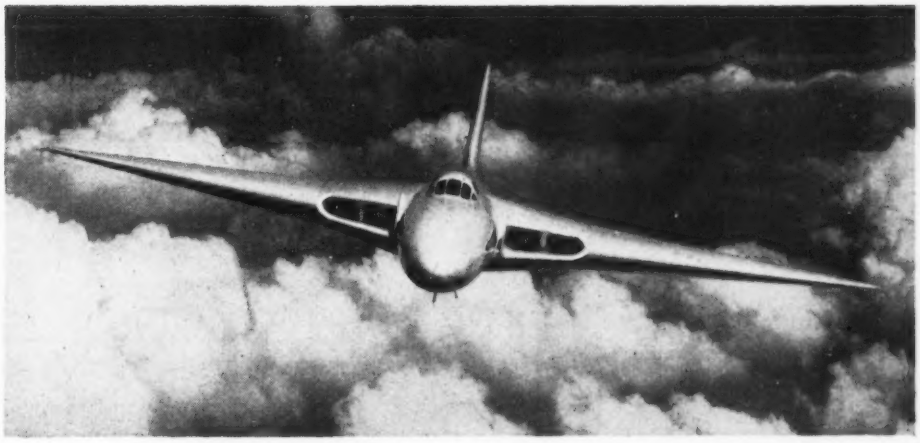
A DESIRABLE luxury for private pilots and clubs owning radio-equipped aircraft is the Lustraphone "Velodyne" microphone, illustrated right and manufactured by Lustraphone, Ltd., St. George's Works, Regents Park Road, London, N.W.1. The microphone can be supplied in a hand-held installation, or as part of a swivelling boom attachment on the headset (as shown). Pilots' own headsets can be individually adapted by the company. The main advantages of the microphone are its lightness (2½ oz) and its ability to exclude background noise, due to the uni-directional field configuration and the steep decline in sensitivity with increasing distance from the noise source.

SINCE its formation at Newtownards in January of this year, the Ulster Flying Club has made steady progress and now has more than 150 members, 14 of whom are apprentices of Short Bros. and Harland, Ltd. A total of 512 hours had been flown in the club's three Tiger Moths by the beginning of this month, and five licences have been obtained.

HOURS flown by members of the London Aeroplane Club during the six months from April 1st to September 30th amounted to 2,274, compared with 1,767 for the same period last year. Thirty-three P.P.L.s and five Commercial Licences were obtained, and 26 members made their first solos. A total of 110 new members joined the club, 78 of whom are from de Havillands. The change-over to the ex-Reserve School buildings on the opposite side of the aerodrome has resulted in improved maintenance facilities, and a pleasant club bar and lounge have been provided.



GULL-WINGED. This syndicate-owned Kirby Gull, seen on launch at Dunstable this summer, still carries the registration letters previously required on all gliders. In the background is the soaring ridge.



FRONTAL ASPECT: Although anvil clouds would obviously be more appropriate as a background for the Avro Vulcan, this head-on photograph by Paul Cullerne is impressive and emphasizes the sharply tapering wing and the huge air intakes, through which over 22 tons of air per minute have to pass.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Cranwell Scholarship Scheme

IN the House of Lords, on Wednesday of last week, the Secretary of State for Air outlined a scheme whereby parents who wish to send their sons to the Royal Air Force College, Cranwell, but who cannot afford to keep them at school long enough to gain the necessary entrance qualifications, would be able to obtain financial assistance from the Air Ministry.

Normal entrance to the College, by competitive examination, is at the age of 18, unless the applicant has sufficient passes in either the General Certificate of Education or the Scottish Leaving Certificate. Without affecting the normal means of entry the new scheme will allow for 60 R.A.F. scholarships, the winners of which will be enabled to remain at school until the required qualifications are attained.

The awards, which will be made four times a year, will be available only to boys whose parents or guardians are satisfied that they genuinely wish to make a permanent career in the Service.

Selection will ordinarily take place as the boys come into the age-group 15 years 8 months to 16 years, but in the first two competitions for places there will be extra scholarships available for older boys, up to 16 years 8 months. Applicants may be attending either independent, direct-grant or maintained schools. Applications should reach the Air Ministry (A.R.1), Whitehall, S.W.1, during December, March, June or September and each must be supported by the boy's headmaster.

Before acceptance, candidates will be required to pass practical and written tests (including questions on cockpit presentation) to assess flying aptitude, a medical examination and an R.A.F. Selection Board. These tests will, as far as possible, take place before the applicant's 16th birthday. A stipulation is that all successful candidates must become members of the Air Training Corps or the Combined Cadet Force as soon as possible, and must be prepared to attend training camps in school holidays if required to do so.

Boys granted a scholarship will remain at school, pursuing the normal course of higher studies until they are 18—unless they qualify for entry to Cranwell before that age. During this two-year period parents or guardians will, according to their means, receive tax-free awards, and contributions to tuition fees if paid, at the following annual rate:

Net income	Award	Percentage claim for tuition fees
£	£	(£100 maximum)
Below 700	50	100
700-899	45	90
900-1,099	40	80
1,100-1,299	35	70
1,300-1,500	30	60

The scheme, as is obvious, is primarily to produce officers for the General Duties branch; but it is possible that a boy might be accepted for the Equipment and Secretarial Branch if his medical category should change during training.

A parent or guardian has to sign an agreement to reimburse the Air Ministry if a boy is withdrawn for "unacceptable reasons" (which are not specified). On the other hand, the Air Ministry commits itself to reserving a place in the College for all boys who qualify and remain medically fit.

Awards

FOR their work in the Korean theatre of war as aircrew and groundcrew of Sunderland flying boats and A.O.P. and Light Liaison Austers the following personnel have been decorated. *Distinguished Flying Cross.*—S/L. J. T. Ormston, F/L. D. H. Clarke, F/L. K. J. Wells, Capt. P. F. Wilson (The Buffs), Capt. P. J. A. Tees (Royal Canadian Artillery), Capt. K. Perkins (Royal Artillery).

Distinguished Flying Medal.—Sgt. E. C. W. Tait, Staff Sgt. J. C. Rolley (Glider Pilot Regt.). *British Empire Medal.*—Sen. Tech. R. V. Pattrick.

Mentioned in Despatches.—Capt. R. S. Deacon (Royal Australian Artillery). F/Sgts. D. Baird, J. A. Bown and R. J. Booth. Sgts. J. J. Regan, R. E. Tait, A. Evans, M. P. Hayward and D. G. Scarle. Cpls. F. D. G. Grogan, D. Fish and R. Ivins. L.A/C. R. T. Pugsley.

The Queen has granted permission for 55 pilots of the Royal Australian Air Force to accept and wear American decorations also awarded for service in Korea. The pilots are all of No. 77 Squadron, R.A.A.F., flying Gloster Meteor 8 aircraft under the operational control of the U.S. Fifth Air Force. Fifteen of the pilots have since been killed or are missing. *American D.F.C.*—W/C. R. Susans, D.S.O., D.F.C. F/L. W. R. Bennett, D.F.C. F/O.s W. B. Rivers, D.F.C. and R. V. Oborn. *American Air Medal.*—W/C. R. Susans, D.S.O., D.F.C. S/L.s V. B. Cannon, E. W. Guy, D.F.C., J. J. O'Donnell, D.F.C., C. G. Thomas, D.F.C. F/L.s W. R. Bennett, D.F.C., L. B. Brown, L. L. Cadan, R. McR. Frayne, J. T. Hannan, K. A. Martin, D.F.C., P. M. Middleton, D.F.C., E. G. Ramsay, D.F.C., R. A. E. Taylor and V. L. J. Turner, D.F.C. F/O.s K. J. Blight, V. Drummond, W. M. Garroway, B. Gogerly, D.F.C., P. V. Hamilton-Foster, D.F.C., E. J. Myers, D.F.M., R. V. Oborn, D.F.M., A. Philp, D.F.C., W. H. Simmonds, B. L. Thomson and K. G. Towner, D.F.M. P/O.s T. C. Armstrong, D.F.M., J. C. Kichenside, K. J. Murray, D.F.C., D.F.M., J. N. Parker, D.F.M. W/O.s K. G. Hill and W. Middlemiss. F/Sgts. F. R. Blackwell, F. T. Collins, J. A. Evans, C. G. King, D.F.M., G. W. Lushey, D.F.M., M. A. Outhwaite and P. Zupp.

Also awarded the *American Air Medal*, but posted as missing, are—F/L. M. A. B. H. A. Browne-Gaylord, D.F.C. and P/O.s E. D. Armit, M. E. Colebrook, D.F.M., and B. T. Gillan. Posthumous awards of the same medal were made to—F/L.s W. V. Gray and I. G. S. Purssey, D.F.C. P/O.s A. J. Avery, D.F.M., L. A. C. Cowper, I. R. Cranston, D. N. Robertson, R. G. Robinson, K. D. Smith, R. A. Strawbridge, D.F.M., J. L. Surman and Sgt. R. Robson.

U.L.A.S. Annual Dinner

THE annual dinner of the University of London Air Squadron, held at the Park Lane Hotel, London, on November 17th, was the occasion of a good deal of merriment and some very fine speech-making. The guests of the squadron included for the first time the Chancellor of the University, the Earl of Athlone, as well as the Secretary of State for Air, Lord de L'Isle and Dudley, V.C. Others present included Sir Henry Tizard, the distinguished aeronautical scientist; Air Chief Marshal Sir William Dickson, Chief of the Air Staff; Air Chief Marshals Sir Hugh P. Lloyd, Sir Francis J. Fogarty and Sir Roderic M. Hill; and Air Marshals Sir Dermot A. Boyle and H. T. Lydford.

When attention had at length turned from earnest occupation with an excellent dinner to the lighter contemplation of port and cigars, the squadron's commander, W/C. A. W. Heward, O.B.E., D.F.C.,

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A.F.C., rose to welcome the guests. Despite his opening reference to that complex mechanism the brain—which, he said, functioned ceaselessly from birth till the moment of making an after-dinner speech—he delivered a masterly speech. Replying, Sir Henry Tizard (who learned to fly 38 years ago), told some highly entertaining stories, from the early days of British military flying, of cross-country flights in Maurice Farmans and experiments with baskets of eggs. He ended on a more serious note by deploring the modern attitude of fatalism in face of the threat of the atomic bomb. He recalled a statement he himself had made before the dropping of the first atomic bomb, to the effect that such weapons might prove the greatest instruments of peace yet produced. The nation's strength, he said, should be made known abroad to command confidence and respect, and to show that we were as great now as we had been in the past.

It fell to Air Chief Marshal Sir William Dickson, in proposing the health of the squadron, to outline the undoubted importance of the university air squadrons as a link between the Service and the "custodians of thinking" in the Universities, and as a source for high-quality recruits.

The reply on behalf of the squadron, by P/O. T. Boston, was a model of what such speeches can and should be; and it culminated in the presentation to the commanding officer of the squadron's coat of arms in heraldic colours, flanked by two containers of the Unit's allegedly staple beverage—two empty bottles of vintage cider *passant, gardant*. The later and mellower hours of the evening were passed in pleasant and convivial diversions.

H.M.S. "Unicorn"

MORE than three years after first receiving orders to return to Britain after service in the Far East, H.M.S. *Unicorn* (Capt. R. R. S. Pennefather, R.N.) arrived back at Plymouth.

Unicorn, formerly an aircraft maintenance carrier and now used for ferrying, was to have come home in the autumn of 1950 but the outbreak of war in Korea caused her departure to be cancelled.

In addition to affording repair and alternative flying facilities for the operational carriers *Triumph, Theseus, Glory, Sydney* and *Ocean*, which succeeded each other in the war zone, *Unicorn* was employed in moving troops and equipment. On one voyage alone she sailed with more than two hundred tons of stores piled on her flight deck. In the course of her duties during the Korean War, she has steamed 110,000 miles.

Moscow Air Attaché

WITH the acting rank of air commodore, G/C. P. L. Donkin, C.B.E., D.S.O., has been appointed air attaché in Moscow. He will succeed A. Cdre. J. C. A. Johnson and take over early in January.

G/C. Donkin has specialized in army co-operation work and has been chief instructor at the School of Air Support. He has attended a course at the Royal Canadian Air Force Staff College and commanded R.A.F. Station Chivenor in Devonshire.

Devon Unit to Move in

THE new R.N.V.R. air unit, No. 1834 Squadron, which has been formed to serve the south-western counties, is to move from R.A.F. Station Benson, Oxfordshire (where it has been formed), to its permanent home at R.N. Air Station Yeovilton, Somersetshire. The move will take place in early January.

No. 1834 Squadron is equipped with Hawker Sea Furies and is commanded by Lt-Cdr. A. C. B. Ford, D.S.C.

Malayan Tactics in Kenya

SEVEN Lincolns of No. 49 Squadron, commanded by S/L. A. Newitt, are now employed in Kenya in a concerted attempt to drive out members of Mau Mau gangs taking refuge in the Aberdare forests. This follows the tactical pattern used with varying success in Malaya over the past few years. The same difficulties are being encountered in that the means employed in the detection of the whereabouts of the Mau Mau H.Q. often gives the gangs ample time to move off before an air attack is staged. The finding of target areas in uncharted jungle is most difficult, as there are very few identifiable landmarks.

Naval Helicopters in Malaya

SINCE arriving in Malaya in January of this year, the Westland-Sikorsky S-55 helicopters of No. 848 Squadron, F.A.A., have flown more than 3,000 hours. In addition to moving 220 sick and injured soldiers from the jungle the squadron has lowered tracker dogs, lifted 9,000 troops and carried 170,000 lb of supplies. No. 848 Squadron is commanded by Lt-Cdr. S. H. Suthers, D.S.C., R.N.

Reserve Liabilities

MOVING the second reading of the Navy, Army and Air Force Reserves Bill in the House of Commons last week, Mr. Birch said that at present the national service reserve accounted for about 400,000 men and would reach its peak of about 500,000 men in the middle of next year. It would not be nearly large enough to meet our needs in the early stages of mobilization and there would be a deficiency of officers, N.C.O.s and technicians of various kinds.

The Government had decided, therefore, that for the next five years both the Z and G reservists and the National Servicemen who completed their full- and part-time training must continue to be liable for call-out in the event of a major emergency. They could not be called out to deal with some colonial embarrassment.

The overwhelming reason for the Bill was the time factor. Mobilization day and D-day might be the same.

Transport Trophy

REPRESENTING Maintenance Command, R.A.F. Station Kidlington, Oxfordshire, has won the Inter-Command M.T. Efficiency Cup and received the trophy, a silver rose bowl, from Air Marshal Sir Owen Jones, Controller of Engineering and Equipment at the Air Ministry.

O.C. No. 615 Squadron

IT is expected that, when S/L. F. B. Sowrey goes to the Staff College in January, command of No. 615 (County of Surrey) Squadron, R.Aux.A.F., will be taken over by F/L. R. A. Eeles, the son of A. Cdre. H. Eeles, C.B.E., who is A.O.C. and Commandant of the R.A.F. College, Cranwell. Sir Winston Churchill is the Honorary Air Commodore of the unit.

Altogether, either as training officer or C.O., S/L. Sowrey has spent five years with No. 615. F/L. Eeles is an Auxiliary officer.

The Last Bomber Lanc

A DINNER has been arranged at R.A.F. Station, Wyton, tonight, November 27th, to commemorate what can only be described as a sad occasion. The last Avro Lancaster in service with Bomber Command is about to be pensioned off. No. 82 Squadron, who will be remembered for their recent photographic survey work in Africa, have been the last to operate this most popular of all wartime bombers, and they are now to re-equip with Canberras.

The Wyton dinner will also have a second purpose, the fêting of the New Zealand Air Race Canberra crews.

Pathfinder Ball

WE are asked to announce that all tickets for the eleventh Pathfinder Ball, to be held at the Dorchester Hotel, London, have been sold.

The ball will have a programme similar to those of previous years. Choristers of St. Paul's will herald the arrival of the Christmas pudding and during the evening a cabaret and floor show will be given.

Reunions

THE Goldfish Club, formed during the war for Allied aircrew who survived a "ditching," is holding a reunion party and display of Air/Sea Rescue exhibits at Ye Olde Cock Tavern, Fleet Street, London, E.C.4, tomorrow, November 28th. Exhibits will include many photographs of actual wartime ditchings and rescues. Tickets for the function, which includes a cold buffet, are 10s each. Details may be had from Mr. C. G. Locke, 78 Morshead Mansions, Maida Vale, London, W.9.

The New Inn Restaurant, Westminster Bridge Road, London, S.E.1, will be the venue for No. 87 Squadron's eighth annual reunion on Saturday, December 5th. Particulars from Mr. A. B. Ebrey, "Seaforth," Southfield, Hessle, East Yorkshire.

FOR TEMPORARY DUTY: The light fleet carrier H.M.S. "Glory" (Capt. R. T. White, D.S.O., R.N.) entering the Grand Harbour, Valetta, Malta, where she will be based for a short tour of duty in the Mediterranean.

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3102-24-11P
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FM.L20-22-1½"B
FK.V3-21-1½"AC
FK.L5-21-¼"AC
FK.B14-23-¼"B
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GK.C3-21-¼"AC
GK.C3-23-¼AC

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GK.S3-21-AC
GK.C4-21-B
GK.M5-21-AC
GK.M5-23-AN
GK.c8-21-¼"AC
GK.C8-23-¼"AC
GK.C8-32-SL
CK.S8-21-¼"AC
GK.9-21-½"AC
GK.9-21-¼"AC
GK.9-21-¼"B
GK.9-23-AC
GK.12-23-B
GK.12-32-SL
GKCL-¼"-ACN
HLP-10H-419
IK.C12-21-1"AC
IK.M30-32-SL
IK.A34-32-SL
LK.N27-21-1"AC
LK.37-21-B.AN
LK.37-23-1½"AC
LK.37-32-SL
LK.A42-32-1½"B
LK.A42-32-SL
LK.A53-32s
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NK.M16-23-¼"B
NK.M16-32-s
NK.V17-32-s
NK.L20-21-¼"AC

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P6-CG-11s
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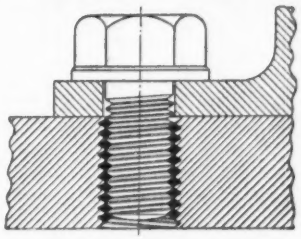

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PATENTS

THE Office National d'Etudes et de Recherches Aéronautiques, 55 Bd Malesherbes, Paris 8º, France, holder of British Patent No. 661,660, granted on November 28th, 1951, "Self-adjustable propeller blades," would like to deal with constructors in Great Britain through licensing. [1352

THE Office National d'Etudes et de Recherches Aéronautiques, 55 Bd Malesherbes, Paris 8º, France, holder of British Patent No. 660,953, granted on November 14th, 1951, "Improvements in jet-propelled aircraft," would like to deal with constructors in Great Britain through licensing. [1350

THE Office National d'Etudes et de Recherches Aéronautiques, 55 Bd Malesherbes, Paris 8º, France, holder of British Patent No. 658,957, granted on October 17th, 1951, "Improvements in or relating to connecting-rod assemblies for radial-cylinder internal combustion engines or pumps," would like to deal with constructors in Great Britain through licensing. [1351

PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:—

Application No. 224 from Manx Airlines, Ltd., of Ronaldsway Airport, Isle of Man, for a seasonal U.K. internal service with Dakota and D.H.89 aircraft for the carriage of passengers, supplementary freight and mail between Newcastle (Woolsington) and Belfast (Nutts Corner) at a frequency of from one to two services weekly initially on Saturdays and later on Fridays and Sundays also, during the season from June 1st to mid-September inclusive, for a period of seven years commencing June 1st, 1954.

Application No. 46/1 from Don Everall (Aviation), Ltd., of Elmdon Airport, Birmingham, for permission to include a traffic stop at Coventry (Baginton) on their seasonal U.K. internal service between Wolverhampton and the Isle of Man (Ronaldsway) (Application No. 46) approved by the Minister of Transport and Civil Aviation for operation on Sundays, during the season from May to September inclusive until September 30th, 1959.

Application No. 225 from Hunting Air Transport, Ltd., of 5 Fitzhardinge Street, London W.1, for a U.K. internal service initially with Dakota and Viking aircraft and later possibly with Viscount aircraft, for the carriage of passengers, supplementary freight and mail between Newcastle (Woolsington) and Belfast (Nutts Corner), with an intermediate traffic stop at Glasgow (Renfrew) at an initial frequency of from one to seven services weekly, during the period from April 1st, 1954 to March 31st, 1964.

Application No. 98/1 from Transair, Ltd., of Croydon Airport, Surrey, for a variation to the seasonal internal service which they have been approved by the Minister of Transport and Civil Aviation to operate with Dakota aircraft at week-ends only between London (Croydon or Gatwick) and Jersey (C.I.) (Application No. 98), advertised in *The Times*, *The Aeroplane* and *Flight* on November 13th, 1953. The company have now withdrawn their request for an extended period of operation, but maintain the remainder of their application.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons, and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9 Buckingham Gate, London S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, must reach them within the period allowed for the making of representations or objections.

THE Council also give notice that the following applications have now been withdrawn:—

Application No. 188/1 from Cambrian Air Services, Ltd., of Cardiff Airport, South Wales, for permission to operate certain of their frequencies on the route Gloucester/Cheltenham-Bournemouth—Guernsey/Jersey (Application No. 188), as a normal scheduled service between Bournemouth and Guernsey/Jersey only, which was advertised in *The Times*, *The Aeroplane* and *Flight*, on October 16th, 1953.

Application No. 219 from Airlines (Jersey), Ltd., of 4 The Parade, St. Helier, Jersey, C.I., for a normal scheduled service between Bournemouth (Hurn) and Paris (Le Bourget) with D.H. Heron and D.H.89A aircraft which was advertised in *The Times*, *The Aeroplane* and *Flight* on October 30th, 1953. [1348

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(5) Radar Assistants

APPLICANTS will be required to assist senior radar engineers in the operation, maintenance and modification of experimental radar systems in the field. Ref. 1190B.

(6) Electronic Laboratory Assistants (Trials)

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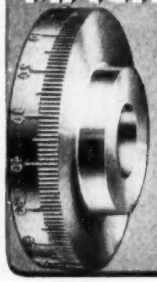

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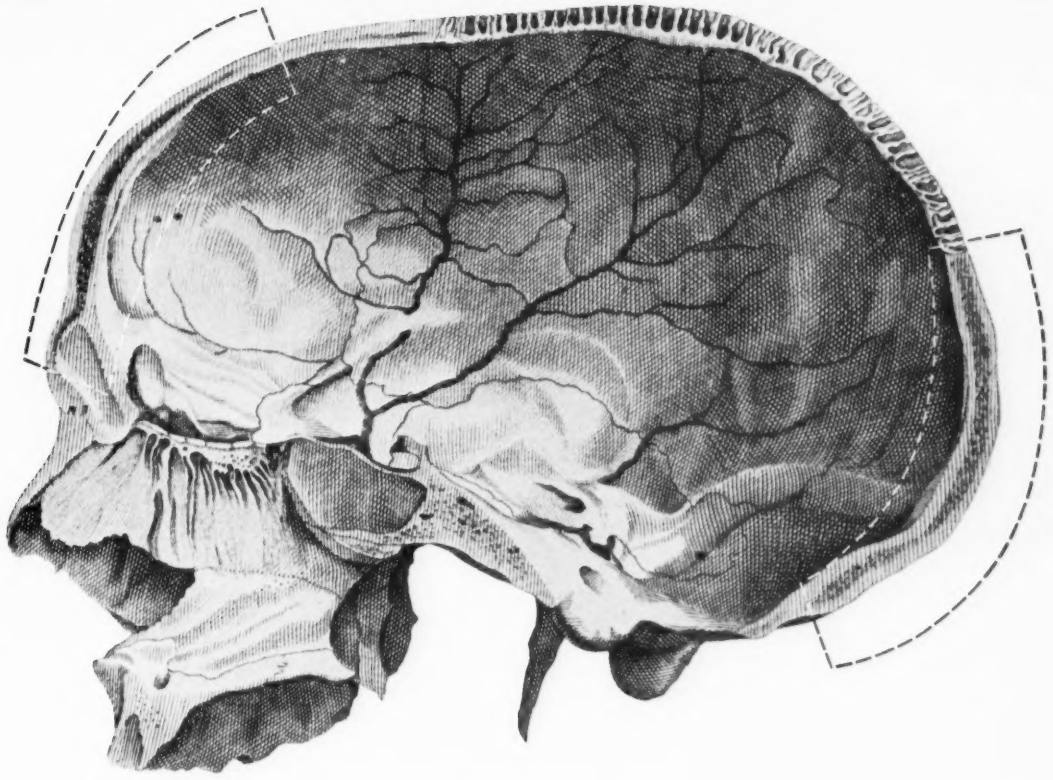

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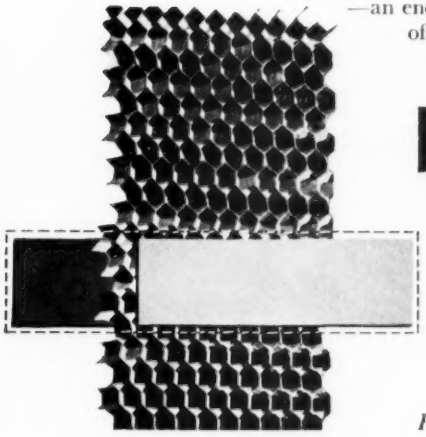

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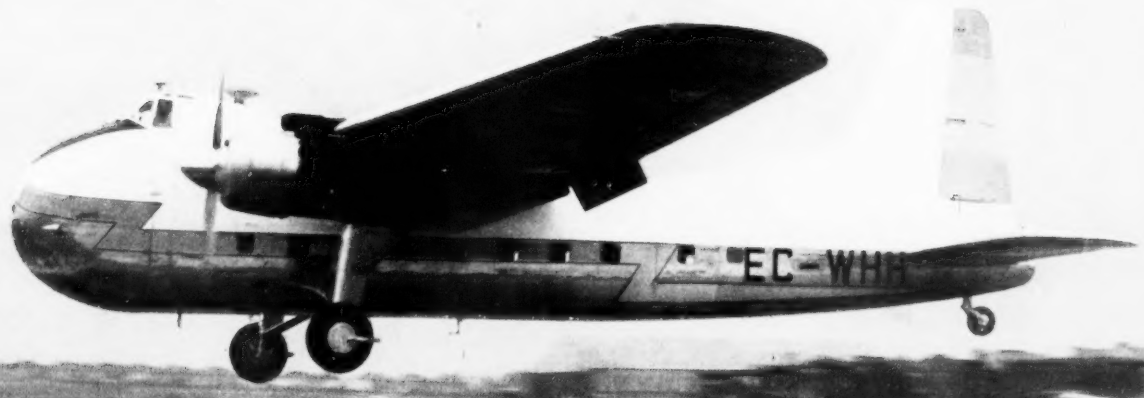

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